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IMPLEMENTATION DIVISION ACTIVITIES 1980

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U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration
Offices of Research and Development
Implementation Division
Washington, D.C. 20590

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Federal Highway Administration

Offices of Research and Development

IMPLEMENTATION DIVISION ACTIVITIES REPORT 1980

January 1981

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Construction Program - Raymond F. Bova
- Thomas A. Larkin
- Edwin Granley
- Douglas Brown

The objective of the Construction Program is to pursue the research, development and implementation of technologies that can be used to improve the quality and methods of highway construction, the use and productivity of construction and engineering personnel, the efficiency of construction to reduce energy consumption, investigate the effects of external influences on highway construction and to clarify contractual responsibilities for the highway agency and the contractor.

In this age of growing physical plants, responsibilities, changing program emphasis, dwindling funds and resources, it is important to improve the efficiency and quality of construction.

Research and field experience are continually providing new ideas and innovative materials that can be incorporated into the pavement system. Many of these items have potential to contribute toward achieving a premium pavement which can last much longer than those currently in service. Projects underway, completed or projected are presented in areas such as:

DESIGN, MANAGEMENT, INNOVATIVE CONSTRUCTION, AND QUALITY ASSURANCE.

Construction Engineering Manpower Management

The New Mexico State Highway Department has submitted their final report on how they implemented this program. New Mexico reports that they now have a system to measure performance against established standards and are able to program cash flow on a routine basis. The report is being printed and will be distributed shortly. Others working on implementing CEMM programs using implementation funds include South Dakota, Minnesota, New Jersey and FHWA direct Federal Offices in regions 8 and 10. They all report to be well underway and reports will be available in 1981 and 1982.

Weigh-in-Motion

Idaho was having a great deal of trouble getting delivery of the truck weighing software due in part to developmental problems. The installation of all the necessary additional equipment was reported to have been installed in July. Evaluation of the system is now underway.

Small Governmental Quality Assurance Program

A contract has been let to Byrd, Tallamy, MacDonald and Lewis to study, evaluate and provide a Quality Assurance system for Pulaski County, Arkansas. An implementation package for a Quality Assurance program will also be generated for use by other government agencies. Completion of the contract will take two years.

Portland Cement Concrete Rapid Testing

The Implementation Division solicited State cooperation in using one or more of the rapid tests in a side-by-side comparison with the concrete testing method they are currently using. Currently, studies are underway in Illinois, Utah, Oregon, Colorado and Oklahoma. Results will be available in late 1980.

PCC Nuclear Consolidation Monitoring Device

The device has been reworked under a Research Contract to provide an accurate reading regardless of the size of the air gap between the device and the pavement surface. Field testing done in the State of New York in August verified that the modifications worked. The device has been offered to interested States for use as an HP&R study.

In Situ Permeability

The prototype device, developed under an FHWA research contract, which quickly measures the in-place permeability of subbase or base materials is currently being evaluated by the State of Pennsylvania. West Virginia, Florida and Washington have been selected to evaluate the device in FY 81.

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Ko Consistency Characteristics of Soils

The Ko Procedure which measures the response of soils under uniaxial strain conditions has been made available to interested states as an HP&R study. This equipment was developed as part of an FHWA research contract.

Determination of Low Levels of Chloride in Concrete

This Kansas procedure which measures differences in electrical potential in situ will also be made available as a suggested HP&R study.

T.T.I. Field Test and Evaluation Center

The "T.T.I. Field Test and Evaluation Center" operates under Contract Number DTFH61-80-C-00040 and provides calibration services on the State inventory units for State Highway Departments and other agencies. This contract, under a pooled fund arrangement, is expected to handle thirteen units this year by providing test, evaluation, and calibration services for the inventory skid measurement systems. As a minimum, these services include:

1. Make pooled fund or other arrangements with the owning agency for scheduling the calibration service.

2. Document the pertinent features of the skid unit.

3. Perform on the Primary Reference Surfaces (PRS) an arrival correlation between the owning agency inventory unit and the Area Reference Skid Measurement System (ARSMA).

4. Instruct inventory unit crew on items which would enhance their capabilites in collection skid measurement data.

5. Conduct a test, evaluation, and static calibration of the subsystems on the inventory unit, and make the necessary adjustments to bring the subsystems into compliance with the American Society for Testing and Materials (ASTM) standard #274-77.

6. Perform a second correlation on the PRS between the inventory unit and the ARSMS.

7. The data and information gathered during the test, evaluation and calibration process are analyzed and the conclusions drawn documented in a report furnished to the owning agency.

The OSU Eastern center now operates independently and users make their own arrangements for correlation services.

"Innovative Materials and Techniques for Durable and Improved Skid Resistant Pavements"

As a part of Contract DOT-FH-11-9641, the contractor's (Jordan/Avent and Associates) principal investigator, has visited the States of Texas, California, Utah, Iowa, Virginia and Pennsylvania. The results of these visits along with other data will be documented in a report due in late 1980.

Skid Training Course

Under the provisions of contract DOT-FH-11-9559, the contractor, Byrd, Tallamy, MacDonald and Lewis, is now in the process of completing a training course entitled, "Skid Resistance Measurement and Design." It is planned that regional courses could start in early 1981.

Geothermal Heating of Bridge Deck with Earth Heat Pipes

A bridge deck near Laramie, Wyoming has been designed using earth heat pipes. A contract for construction of the bridge was awarded on July 17, 1980, to Structures, Inc. of Riverton, Wyoming. The contractor has completed a temporary by-pass and the heat pipes are also under construction. Instruments for weather and deck status monitoring have been ordered. Completion of the structure is expected by April 1981. Testing will start in late 1981.

DELINEATION PROGRAM - Charles W. Niessner

The objective of the delineation program is to develop and evaluate new and/or improved and practical traffic lane delineation materials and systems that will provide the desired day and wet/night delineation for a safe highway system.

The Implementation Division's efforts in this program can be categorized into four general areas: (1) development and evaluation of more durable pavement marking materials; (2) expanded use of raised pavement markers; (3) improved methods for pavement marking removal; and (4) evaluation of roadside post delineators.

During 1980 several projects were completed and the final reports distributed to the field. These projects were on Surface Preparation of Pavements Prior to Striping (FHWA-TS-80-207), Improved Stripe Removal by High Temperature Burning with Excess Oxygen (FHWA-IP-80-6 and FHWA-TS-80-208), and Recessed Snowplowable Markers (FHWA-TS-80-225). In addition studies on reflective marker paint stripe skipper, delineation handbook and the evaluation of retroreflective measuring devices have been completed and the final reports are being prepared for printing.

In 1981 the major program emphasis will be directed toward the five workshops on durable pavement marking materials and the workshop on snowplowable markers. The workshops will provide the input to our future delineation program.

Surface Preparation of Pavements Prior to the Application of Pavement Markings

This project was undertaken to demonstrate that surface preparation of pavements by wire brushing prior to the application of traffic marking paint would result in extended service life of the paint. It was found that brushing did not significantly extend the service life of the paint. The results of the study are summarized in Report FHWA-TS-80-207.

Nontoxic Yellow Paint

The Office of Research has developed a nontoxic yellow paint by replacing the lead chromate with an organic pigment. Task orders have been initiated with Maryland, New Jersey, Nebraska, and Texas to conduct a field evaluation of this material. The test sections were placed during 1980 and are currently undergoing a one year evaluation period.

Thermoplastic/Primer Systems

Under a contract with the Texas Transportation Institute, the Office of Research developed several promising thermoplastic/primer systems with improved durability. Projects have been initiated in Alaska, New York, Oklahoma and Region 15 to install and evaluate this material. New York completed their installation in September 1979. The remaining test sections were placed during the summer of 1980.

Epoxy Thermoplastic (EPOFLEX) Pavement Marking Material

This material was developed by Southwest Research Institute under an FHWA contract. Task orders have been initiated with New Hampshire and Illinois to determine the feasibility of retrofitting existing striping equipment to apply this material. This work will be completed in the spring of 1981.

Retro-Reflective Measurement Instrument (Evaluation)

Mobility Systems and Equipment Company is the contractor on this study to evaluate the various types of instruments for measuring the retro-reflectivity of pavement markings. The contractor has completed the study and submitted a draft final report. The final report will be distributed in early 1981.

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Durable Pavement Markings--Workshops

A contract has been signed with DAI to conduct five workshops on pavement marking materials during 1981. These workshops will be held in February, March, and April and primarily will deal with the more durable materials such as thermoplastics, epoxy, polyester, EPOFLEX, etc.

Construction Zone Delineation (Raised Pavement Markers)

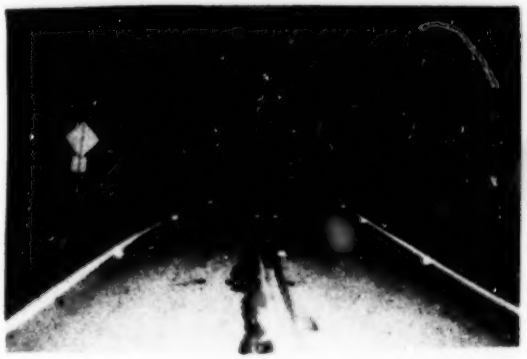
The final report, FHWA-TS-78-222, was distributed in January 1979. Approval has been received from the Office of Public Affairs to produce a film on the use of raised pavement markers in construction zones. Film footage has been received from Arkansas, Kansas, Nebraska and Mississippi. The film footage is presently being edited and a script prepared.

Recessed Lane Markings

The State of Washington is evaluating different methods for cutting grooves and various pavement marking materials placed in the pavement recesses. The installation was placed in September 1977 and has undergone two winters of evaluation. The project will be evaluated through the winter of 1980-81 and a final report prepared.

Raised Pavement Markers at High Hazard Locations

Eleven States are participating in this study to evaluate the effects of raised pavement markers at high hazard locations. The field installations are primarily located on two-lane rural roads. All of the installations have been completed and the collection of data for the "after" period is underway. The project will be completed in July 1981.



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Recessed Snowplowable Markers

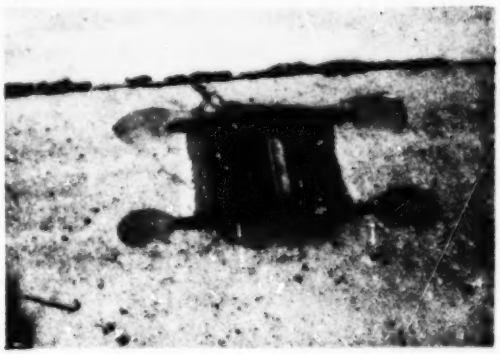
This marker system consists of a five foot groove with a reflector placed at the end of the groove. The reflector is set just below the pavement surface to avoid contact with the snowplows. New York, Utah, and Virginia have completed their field evaluations of this system. A summary report (FHWA-TS-80-225) has been prepared and distributed by the Implementation Division.

Reflective Marker Skipper

The California Department of Transportation and Ohio Department of Transportation have developed devices, one optical and the other magnetic, to avoid painting over the raised reflective pavement markers. These devices are mounted on the paint striper and automatically turn the paint guns on and off to avoid the markers. Louisiana and Kentucky conducted additional field evaluations of the California instrument. A draft final report has been prepared and is in the review process.

Snowplowable Markers

A task order has been negotiated with Kentucky to conduct an evaluation of the durability of various types of snowplowable marking systems under actual field conditions. The markers will include Stimsonite 96, King Ray, Durastone and a grooved reflective marker. The evaluation period will be for one year after installation.



Rapid Set Epoxy Adhesive

An FHWA research contract has developed a rapid set epoxy adhesive for installing raised pavement markers. In order to more fully evaluate this material, task orders were initiated with Mississippi and Oklahoma to place large scale field installations. The markers were installed in 1980 and the evaluation period will be for one year.

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Snowplowable Markers--Workshop

A workshop on snowplowable markers is currently being developed. The workshop will be held on February 3rd and 4th, 1981, in Columbus, Ohio.

Stripe Removal--Modification of Excess Oxygen Burner

The removal of pavement marking by high temperature burning with excess oxygen was originally developed by Southwest Research Institute. The Texas Department of Highways and Public Transportation has completed a project to modify the equipment. The work has resulted in the development of a new burner head with improved operational characteristics. A new implementation package (IP 80-6) including a film on the operation of the equipment has been prepared and distributed.

Stripe Removal--Scoring/Jetting Equipment

Renn Engineering Company has completed the fabrication of the scoring and jetting equipment for stripe removal. A purchase order has been negotiated with Renn to conduct additional field evaluations and modifications, if necessary, to the equipment. It is anticipated that the work will be completed by January. 1981.

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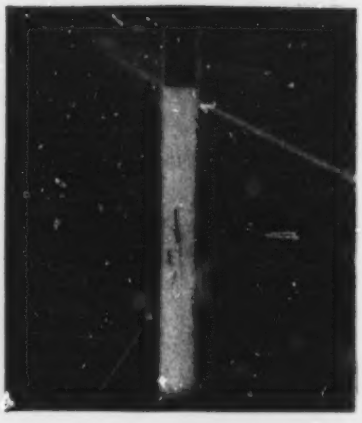
Field Evaluation of Post-Mounted Delineators

Nine States are participating in this project to evaluate the costs and effectiveness of various types of post-mounted delineators. All of the test installations have been completed and the "after" data are now being collected. This project will be completed in March 1981 and a summary report prepared.



Delineation Handbook

An FHWA contractor is preparing a handbook on Roadway Delineation Practices. The handbook is intended for city, county, and other local jurisdictions that are responsible for the installation and maintenance of pavement markings. The reproducible copy of the handbook is being reviewed and prepared for printing.

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MAINTENANCE PROGRAM - William L. Klockenteger
- Charles W. Niessner

Total highway maintenance expenditures were estimated to have exceeded $12 billion in 1980. Optimizing maintenance activities are, therefore, of utmost importance to the highway manager. The research and development program has focused on management and material and equipment development with value engineering studies evaluating existing operations.

Highway Maintenance Research Needs Study

The Transportation Research Board is currently wrapping up the contract to determine the maintenance research program for the next five years. The program was formulated by bringing together State maintenance and research engineers, university professors, private consultants, local engineers and Federal engineers at four regional meetings. The input collected at these meetings was consolidated at a national meeting held in Minnesota. Some of the 21 research topics are as follows:

1. Development of a Pavement Maintenance System.

2. Development and Evaluation of Calcium Magnesium Acetate (CMA) for Deicing Purposes.

3. Development of Methodologies for Improved Technology Transfer in Highway Maintenance.

4. Development of Cost Effective Maintenance Strategies.

5. Synthesis of Innovative Conservation Techniques for Highway Maintenance.

6. Development of a Rational Decision Making System for Vehicle Fleet Selection and Use.

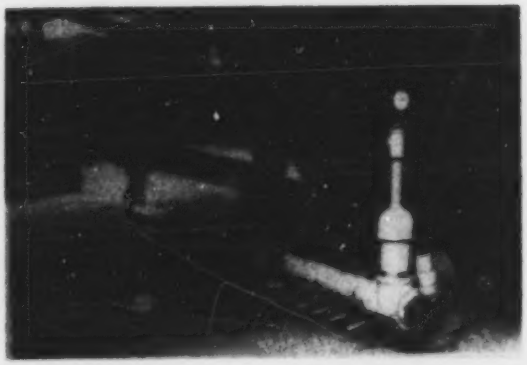
7. Effect of Future Traffic Mix Upon Maintenance Resources in Safety Appurtenances.

Pavement Patching--Demonstration and Evaluation

Colorado, Connecticut, and Oregon were selected to place 15 patching materials (ten bituminous and five portland cement) and evaluate the performance of the materials for one year. All the materials have been placed and are being evaluated. The contracts run until February 1981, and the reports will be published soon after.

High Pressure Salt-Brine Deicer

Connecticut has developed a high pressure salt-brine deicer for the removal of snow and ice from the roadway. The Implementation Division has purchased two of the machines which will be evaluated by the States of Minnesota and Utah this winter. In addition, California has built its own unit for evaluation. Early testing by Connecticut indicates that the salt-brine deicer is an effective snow and ice remover and under certain conditions can save up to 80 percent of the normal salt requirements.



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Litter Pickup Machine

The construction of a machine to remove litter from the roadway surface was initiated in 1977 and completed in 1979. The machine was tested and evaluated in Illinois, Ohio, and Pennsylvania during 1979. The modifications recommended by these States have been designed. It is planned to test the machine for a full season when the modifications are completed.

Mechanization of Bituminous Patching

A study by Ohio State University to develop the concept for a mechanized pavement patcher was completed this year. Their recommendation was to develop a modification of an existing machine, the Gabriel Perma-Patcher. Presently, the States of Colorado and Texas are evaluating the machine and its patches.

Equipment Management Systems (EMS)

Five States were originally commissioned to evaluate and implement the EMS. These were California, Idaho, Arkansas, Kentucky, and New Mexico. Idaho has successfully implemented the system and is presently using it in their maintenance operations.

The second EMS symposium is scheduled to be held in March 1981 in New Mexico. The first symposium, held in Arkansas, proved to be very informative to the attending States and Canadian Provinces.

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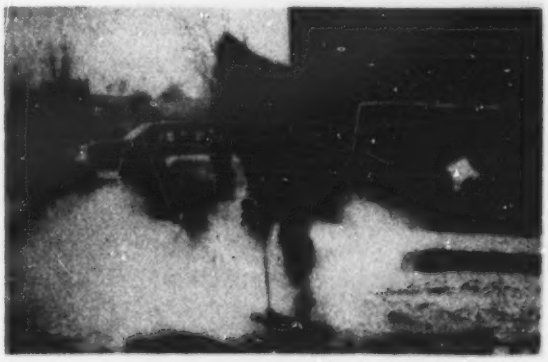
Optimizing Maintenance Expenditures (Value Engineering Studies)

Two additional studies in this series of projects evaluating maintenance activities were completed and the reports distributed. These two studies were on Rest Area Maintenance (FHWA-TS-80-210) and Pavement Joint Repair (FHWA-TS-80-215). This makes a total of ten studies that have been completed over the past five years. One other study on Mowing Operations has been completed and the report is being prepared for printing. A two day conference on Value Engineering was held in Dallas, Texas on April 8-9, 1980. The conference was attended by approximately 80 people from Federal, State, and private industry. A summary report on the conference is being prepared for distribution.

High Pressure Water Jet for Concrete Removal

A feasibility study and field demonstration conducted by Illinois Institute Transportation Research Institute (IITRI) under a joint project with FHWA and the National Science Foundation (NSF) showed that the high pressure water jet is superior to the conventional methods for cutting and removal of concrete. In order to further develop this method of rapid concrete removal, a contract has been signed with Daedalean Associates Inc., to construct and evaluate a prototype unit. Work on this project began in September 1980 and will be completed in March 1982.



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PAVEMENT PROGRAM - Raymond F. Bova
- Edwin C. Granley

The objectives of the pavement program are to optimize the use of conventional and new materials and pavement systems and to improve design methodologies in order to protect the total highway pavement investment by increasing the life cycle of the pavement system and reducing maintenance costs. Highway safety, preservation of the environment, and conservation of energy and materials are considered in each element of the program.

Research and field experience are continually providing new ideas and innovative materials that can be incorporated into the pavement system. Many of these items have potential to contribute toward achieving a premium pavement which can last much longer than those currently in service.

Flexible Pavements (VESYS II M)

Florida is currently retesting samples with their modified test equipment to determine comparisons with previous tests. They plan to use it for verifying their conventional pavement designs to those based on this system.

Zero Maintenance

An FHWA research contract with CMT, Inc. has been modified to implement the EAROMAR program in two States. Work is presently underway with Massachusetts DPW. An implementation handbook will be prepared for use by designers to analyze their projects without using a computer. The handbook will be available in 1981.

Pavement Management

The Tumwater report on Pavement Management has been reprinted due to increased interest in the subject.

The first Pavement Management Workshop was held in Phoenix, Arizona, May 19-21. The second workshop was held in Charlotte, North Carolina, September 22-24 for the eastern half of the country. The final report is expected in mid January, 1981. Participants to the workshop represented a good cross section of the pavement field from local governments, states, universities and consultants. The workshops identified the state of the art of PM and future needs for implementation.

"Pavement Management, Principles and Practices" - a training course requested by Office of Engineering has been developed and will be presented by NHI in FY 81. The 3 day course is aimed at administrators and program managers having pavement management responsibilities.

3 R Program

The second pilot for "Resurfacing, Restoration and Rehabilitation of Pavements" course was presented June 9 in Indiana. The course was very well received. The contractor will be submitting the final work shortly. NHI expects to present the course in 1981

Multi-State Pavement Management Study

The Multi-State Pavement Management Study being conducted by five States in Regions 6, 7 and 8 is well underway. The last of four meetings was held in Des Moines, October 22 and 23. The study concentrates on thermal cracking of bituminous pavements. A final report will be distributed in 1981.

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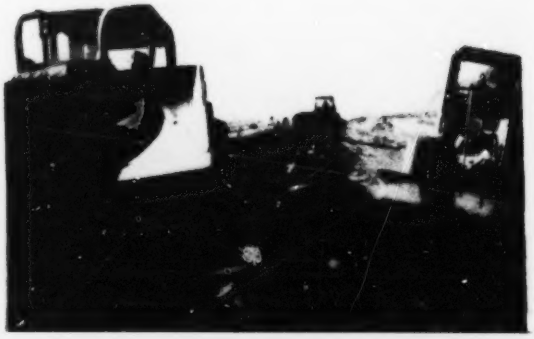
Recycling

A National conference on bituminous pavement Recycling conducted by TRB was held October 14-16, 1980 at Amfac Hotel in Dallas, Texas. The conference was attended by 450 people. A second conference on PCC recycling and rehabilitation will be held in St. Louis, Missouri in September 1981.



Water-in-Pavements

The "Highway Subdrainage Design" guide prepared by Dr. Lyle Moulton has been printed and a limited distribution is scheduled in FY 81. A 1981 procurement action will be undertaken to prepare a training course to further implement the concepts used in the manual.

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POLYMER PROGRAM - John J. Bartholomew
- Thomas A. Larkin

The objective of the Polymer Program is to provide highway and transportation agencies with procedures for using concrete-polymer materials to prevent and/or repair deteriorated concrete. Deterioration of concrete bridge decks has made major repairs of many bridges necessary 5-10 years after their construction. The most prevalent cause of this premature deterioration is stress induced by corrosion of the reinforcing steel due to the intrusion of chlorides into the concrete from the application of deicing salts. Similar deterioration occurs to concrete exposed to a marine environment. Research indicates that concrete-polymer materials are extremely durable and provide a high resistance to deterioration. Field procedures have been developed for repair work and rehabilitative polymer concrete overlays.

Nine polymer concrete overlays have been placed. Preliminary results show the overlays to be impervious to water and deicing salt penetration. The skid numbers have generally been in the high 50's to low 60's with a high of 73 for an overlay recently placed in Oregon.

Polymer Impregnation of New Concrete Bridge Deck Surfaces

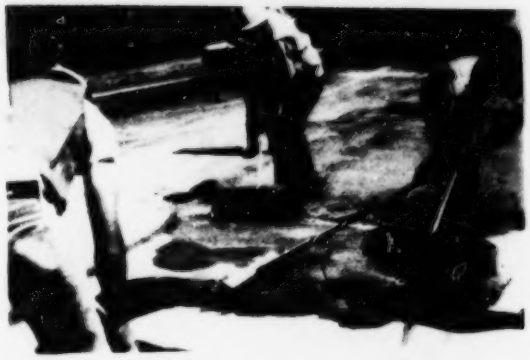
The staff study covering the work completed to date has been delayed until the test results from several projects are received. The Georgia and Maine results should be completed by mid 1981 and the final report will then be prepared.

Polymer Concrete Patching Materials

The four States selected for the polymer concrete patching study, Maine, Minnesota, Nebraska and South Dakota, have been contacted and the Task Orders have been prepared. Maine will place the material during the week of November 17, 1980, while the three other States will do the work next spring. Oregon may also participate, if they find the right location.

Region 15's Demonstration Project Division has a demo project being planned (#51) that will include polymer concrete patching material. A small pilot project has been initiated by Region 15 to use about 5 cubic yards of polymer concrete to patch 1 or 2 decks in the Northern Virginia area. The work started in October and will continue throughout the winter.

Polymer Concrete Overlays



The purchase order with Brookhaven National Laboratory (BNL) was executed on July 10, 1980, and will provide for technical assistance, equipment and materials evaluation for the Type B, built-up polymer concrete overlay system. The work will span three years.

The Oregon DOT constructed a Type B overlay using a vinyl ester resin and sand purchased locally. The bridge, located in Independence, is 40' X 80'. Construction of the overlay was completed in two days. Evaluation will be completed by Oregon, and a full report will soon be available. The Idaho Transportation Department completed the construction of a 1 3/4 inch thick Type A overlay at Murtaugh. Unlike previous attempts on the same bridge, the overlay was placed with few problems.

Overlay projects in New Mexico and Texas were completed in October. Both States used a polyester resin to place Type B overlays with State maintenance forces.

A $10,000 purchase order with the Georgia DOT was recently signed. The purchase order will provide for the development of prototype equipment to mix resin and spread sand for Type B overlays. The equipment should be ready for initial field trials in FY 81.

Virginia recently signed a $20,000 contract for the evaluation of 5 Type B overlays to be constructed on I-64 near Williamsburg. The construction contractor is currently widening the structures. The consultant responsible for the overlays is designing and fabricating the overlay equipment. The bridge deck overlay work will begin next spring.

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SOILS AND FOUNDATIONS PROGRAM

- Chien-Tan Chang
- Anthony M. Lizzio
- John M. Hooks

The objective of the soils and foundation program is to provide geotechnical engineering personnel with the essential knowledge of the new technology developing in this field. This is being accomplished through studying, organizing, developing and conducting numerous projects on geotechnical engineering.

The increasing cost of our highways requires adoption of the latest principles of geotechnical engineering. Bold new techniques are needed to make accurate descriptions and predications of soil and rock movement. Research in this field has resulted in many new concepts and methods to improve highway and maintenance costs. However, much of this research is very technical in nature and will require additional development before effective utilization by most practicing engineers will be possible.

Engineering Fabrics Training Course

Use of Fabrics in highway construction has greatly increased in recent years. To meet this increase and provide appropriate training for highway engineers, the Implementation Division in cooperation with the Geotechnical Branch has sponsored development of a fabrics training course. Haliburton Associates from Stillwater, Oklahoma was selected as contractor to develop and conduct the training courses. The first workshop is planned for the summer of 1981 and the second and third will be held in late 1981 in both a western and an eastern State.

Evaluation of Engineering Fabrics by Florida

The State of Florida is constructing a 13-mile embankment in Palm Beach County, Florida using filter fabrics as a separator between the embankment soil and the foundation organic soils. In conjunction

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with this project, the Implementation Division has sponsored a study to evaluate the performance of the fabrics being installed.

For evaluation purposes, three 1/2-mile sections were installed with 3 types of fabrics, i.e., Mirafi 500x (woven), Typor 3401 (non-woven), and Mirafi 140S (non-woven). A decision has been reached to use 2 types of fabric (Mirafi 140S and Typar 3401) throughout the 13 mile embankment. The sections were heavily instrumented with settlement platforms, sensors, and slope indicator casings.

Pile Group Prediction Symposium and Proceedings

A pile group prediction symposium was held on June 25-26, 1980 at the University of Maryland Campus in conjunction with the FHWA Pile Research Project in Houston, Texas. Approximately 140 engineers from 11 States and Canada attended the symposium. It was successful and well received. Symposium proceedings are being prepared by the Implementation Division staff and are expected to be published by the end of 1980.

Shale Embankment Summary Report

A shale embankment summary report prepared for the workshops in Kentucky and South Dakota has been printed. The report provides basic understanding of the shale embankment construction problems and the solution to these problems. It was distributed in October 1980.

Expansive Soil Summary Report

In conjunction with FHWA research, a workshop was held in Oklahoma and South Dakota in April and May 1980. A summary report prepared for the workshop was distributed in October 1980. The report provides basic understanding of the swelling soil problems and their solutions.

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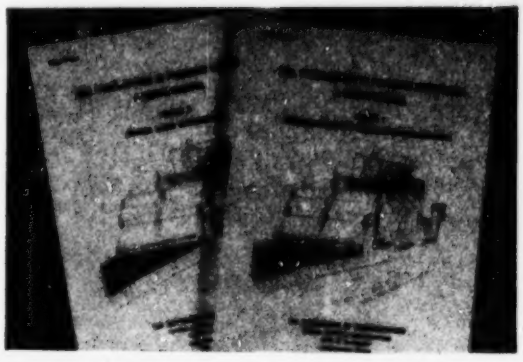
Soil Stabilization in Pavement Structures

The two-volume Implementation Package on the above subject was distributed to the field offices in May 1980. The report was well received by States and other engineers. Additional work on soil stabilization, mainly the low volume roads, is being handled by the Office of Research. When the work is completed, the Implementation Division plans to hold a workshop to further disseminate the soil stabilization technique.



Evaluation of the Clegg Impact Tester

The Clegg impact test developed by Dr. Clegg of the University of Western Australia, is an alternate device for measuring CBR values. The device, if correlated with conventional testing devices, could reduce laboratory testing and also provide a quick field check during construction to verify the design pavement sections. A set is being purchased for FHWA evaluation.

Wave Equation

The updated version of the WEAP program distributed by FHWA in 1977-1978 is being developed to meet the increased use of the wave equation in the analysis of pile foundations. The program and documentation are nearly completed and are expected to be made available to users by the end of 1980.

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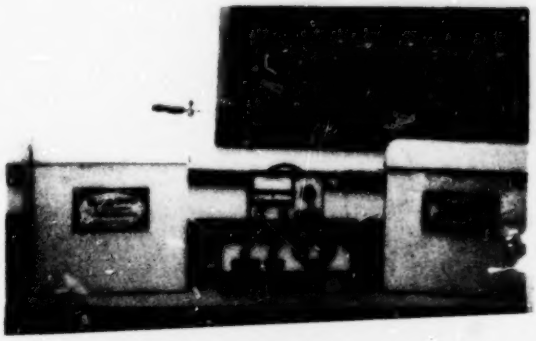
Evaluation of Soil Suction Testing Procedure

An FHWA research result indicated that the soil suction testing device provides a better characterization of the behavior of expansive soils and a more reliable estimate of volume change. Presently, the FHWA Region 8 and 2 State highway offices, Arizona and Texas, are performing an independent evaluation of the soil suction device.



Course on Geotechnical Instrumentation

A 5-day course on geotechnical instrumentation for highway construction and heavy maintenance (landslide correction, etc.) has been developed to train engineers in this specialized area. The course is designed for geotechnical engineers, bridge engineers, geologists, and instrumentation specialists involved in the design or construction of highway facilities dependent on stability of soil or rock masses. Two pilot sessions were held in February 1980 in FHWA Regions 5 and 9. The course package has been finalized and printed and the course is scheduled to be presented one time in each of the FHWA Regions during the first two quarters of FY 81. The sessions will be conducted by the course developers, Mr. John Dunnicliff and Mr. Barrie Sellers.

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STRUCTURES PROGRAM - Anthony M. Lizzio
- John M. Hooks
- Robert C. Wood

The objective of the structures program is to further develop, test, evaluate, and implement the most promising structural research findings, on a priority basis, to ensure that our nationwide bridge system is safe, serviceable, and economical to build and maintain.

Most of the new bridge building that was financed as a result of the Interstate program is nearing completion, and the major effort in the coming years will be to replace obsolete or structurally deficient bridges and to properly maintain existing structures.

There are many problems related to these older structures: bridge deck deterioration, bridge cracking and corrosion, bridge rail safety, joint failures, pile foundation failures, and the continuing bridge maintenance. The activities in the Structures Program have previously shown potential in solving the various problems.

Bridge Corrosion Cost Model

A simulation model (computer program in Fortran IV) has been developed under the FCP program as a tool for decisionmaking on maintenance policies for painting of highway bridges. A task order to evaluate the adaptability and usefullness of the program was signed with the Florida Department of Transportation in August 1980. The State has adapted the program to their own computers and is evaluating several of the program's optional segments using input data from their own experience as well as the data provided by the program's developer. The results of the task order, which is scheduled for completion in the fourth quarter of FY 1981, will include program modifications and a revised user's guide.

Evaluation of Commercial Blast Cleaning Systems

Three States, New Jersey, Florida, and Texas, participated in a project to evaluate commercially available alternates to dry sandblasting for cleaning structural steel. Candidate systems ihcluded a water-abrasive blast, a recovery system using metal

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shot and a vacuum at the nozzle, and flame cleaning. The systems were compared to conventional dry sand blasting with regard to cost, effectiveness and potential to reduce pollution. Miscellaneous applications such as cleaning up graffiti were tried. A meeting of all three States to discuss preliminary results was held in Jacksonville, Florida, in February 1980. All three States submitted final evaluation reports and New Jersey has combined the results into one evaluation report which will be distributed to the field in early FY 1981.

Training Course for Bridge Paint Inspectors

The quality of inspection on bridge painting projects has been identified as a major problem in the effectiveness and premature failure of coating systems on steel highway bridges. The need for a training program for inspection personnel has been stressed by local, State, and Federal officials. In response to this need, the Implementation Division has developed a four day classroom and field training course to meet the needs of State highway agencies for training and motivating inspection personnel. The course material has been developed in final draft form and two pilot sessions were held in New Jersey in November, 1980, and in Missouri in December 1980.

Training Aids for Maintenance Bridge Inspection

Title 23 requires the inspection, coding and inventory of all public bridges including all the off-system bridges under the jurisdiction of over 4,500 separate county, parish, and city governments. Since the off-system inspections must be completed by December 1980, there is an urgent need to train bridge inspectors at the local government level to meet the legislative inspection requirements. The Implementation Division, the Bridge Division, and the National Highway Institute are cooperating in an effort to develop training aids for that purpose. Supported by funding from the Implementation Division, the Oregon Department of Transportation with assistance from the Oregon Division and Region 10 has completed three of the proposed five tape series, i.e., introductory tape, timber bridge and steel truss. Oregon has declined to continue the work to finish the series. The three tapes are being duplicated and will be made available to the States. A State or contractor to complete the remaining two tapes is being sought.

Wabash River Bridge

The construction of the Wabash River Bridge by incremental launching of precast prestressed segments has been completed. The project engineers were extremely pleased with the use of the launch techniques and are optimistic about the potential benefit of this erection method for other new structures. The Indiana State Highway Commission has documented the unique features of the design, fabrication, and construction of the bridge in a very informative slide tape presentation. The slide tape was made available to the field offices in April 1980 and is being offered to interested parties on a loan basis.

Long Key Bridge

The Long Key Bridge is a new type segmental bridge being built by a span by span erection method in the Florida Keys. The construction of the new type segmental bridge is underway with a typical construction rate of two full spans per week. The span by span erection technique has proved so successful that the contractor, on occasion, has been able to complete three full spans in one week's time. A report to document the key design and construction features of this bridge is being prepared by the Florida Department of Transportation under a task order.

Linn Cove Viaduct

The Linn Cove Viaduct is a new segmental bridge to be built on the Blue Ridge Parkway in North Carolina. The design engineers have been hired to prepare a formal documentary report describing the unique features of the design, fabrication, and construction of the new bridge. The outline of the technical documentary report has been written. The consultant, Figg and Meuller, will prepare the sections of the report as key stages in the construction are reached.

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Portable Recorder for Bridge Stresses

The Kansas Department of Transportation has completed the evaluation of a portable instrument which detects and records occurences of preset stress levels in steel bridge girders. The data from this instrument can be used to assess the expected life of existing bridges. The final report on the evaluation has been completed and will be published early in FY 1981. The need for further evaluation and development of the instrument is currently being assessed. Factors to be considered include: need for more reliable power source; provision for remote collection of data; improved counters; potential application to analyzing stresses in auxiliary highway fixtures such as signs, posts and light poles.

Welding Temperature Monitor

The Maryland Department of Transportation has completed work on fabrication of two "production models" of a welding temperature monitor. The device can be used to electronically monitor the temperature of weld metal on fracture critical members. A variety of methods for signalling the attainment of a preselected temperature can be connected to the device. Evaluation of performance of the device is planned for FY 1981 and two States are being sought. Maryland Department of Transportation personnel will demonstrate and operate the device during each of the two evaluations.

Specifications for Steel Box Girder Bridges

A project to develop new specifications for steel box girder bridges has been completed. The final report, FHWA-TS-80-205, "Proposed Specifications for Steel Box Girder Bridges" was distributed in January 1980. The report was well received by potential users and was used as a reference by the designers of the West Seattle Bridge. The principle investigator was on hand to discuss the report's recommendations at the 1980 International Conference on Steel Bridges at Cardiff, Wales. The proposed specifications were generally acknowledged to be the most advanced, and at the same time, most useable in the world to date. The contract manager summarized the current status of the recommendations at the Region 1 meeting of the AASHTO Bridge Committee. A follow-up study to provide design examples is being considered as a joint effort with AISC.

Design and Construction of Welded Bridge Members and Connections

In spite of advances in materials, design and fabrication, several steel bridges have experienced structural failures due to brittle fracture within the last two decades. Warren N. Samarzich and Associates, Consulting Engineers, have developed a 4 1/2-day workshop to inform the bridge engineer about the practical aspects of design and construction that may minimize fatigue and fracture problems. Pilot workshops were presented in Denver, Colorado and Washington, D.C. in June and September. Future presentations of the workshop will be presented by the National Highway Institute.

Welding Inspection for Steel Bridge Fabrication

A request for proposal (RFP) to develop a comprehensive, well illustrated instructional manual and training course on the fundamentals of fabrication welding inspection and quality assurance for steel highway structures has been issued. No suitable course for training bridge fabrication welding inspectors is available at the present time. Development of such a course, along with a suitable welding inspectors manual, is identified as a critical national need in steel bridge fabrication. Pilot workshops will be presented in San Francisco, Dallas and Washington, D.C. during calendar year 1981.

Design Manual and Slide Tape Presentation for Bridge Structural Members Under Wind Induced Excitation

This project entails the develoment of design charts, graphs, and examples that will aid the bridge design engineer in analyzing vortex excited vibrations of long slender bridge members. The contractor, Chi Associates, Inc., is condensing material from research report document FHWA-RD-78-25, "Response of Bridge Structural Members Under Wind Induced Vibration". The design manual and slide tape presentation will be available in January 1981.

Structural Plastics Design Manual

The first phase (four chapters) of the structural Design Manual was printed and distributed to the field in 1979 and has been well received. Work is continuing on Phases II and III which includes chapters on Fire Safety; Design of Plates and Membranes; Design of Beams, Columns and Flat Panels; Design of Sandwich Structures; and, Design of Thin Rings and Shells. This $150,000 joint industry-Government project will be complete in FY 1981.

Structural Plastics Selection Manual

A formal contract was signed on August 1, 1980, through the American Society of Civil Engineers with the University of Delaware to prepare a structural plastics selection manual. This new manual will be complementary to the structural plastics design manual and will assist the designer in selecting the type of plastic characteristics needed for the particular application. The project is expected to be completed by mid 1983. Support of this effort is being provided through Government and industry R&D funds.

Steel Bridge Inspection, Testing and Analysis

Materials Research Laboratory, Inc. completed a failure analysis study and report on the cracked steel girder of the Third Street viaduct in the city of Columbus. The failure was similar to the crack in the LaFayette Street Bridge in St. Paul, Minnesota.

California State University is nearing completion on its failure analysis of the cracked tie girder of the Prarie Du Chien tied arch structure in Wisconsin. The contractor has concluded that the crack was initiated by the combination of the residual stress produced during welding and the inherent brittleness of the approximately one-half inch thich zone located in the center of the top flange of the tie.

CALTRANS is selecting Laboratories to participate in the round robin metallurgical test program for A3J E24.03.03.

Work is expected to continue in Fiscal Year 1981 through conducting failure analysis studies of steel bridges that have failed due to fatigue cracking so that the data and information can be stored and provided as feedback to the practicing bridge engineers.

TUNNELS PROGRAM - John M. Hooks

The objective of the Tunnels Program is to evaluate and implement the most promising results of tunnel research as well as innovative materials developed outside of this country. The ultimate goal is to provide methods to economically and safely design and construct tunnels. The critical problems in tunneling involve excessive cost, long construction times, and uncertainties which can lead to even higher costs, longer construction periods, and unsafe conditions. More specifically, inadequate site investigation often leads to overconservative design, construction delays, cost overruns, and safety hazards. The continued evaluation and implementation of new hardware and techniques for site investigation are now addressing these problems. Another specific example is the continued use of inefficient or unsafe ground support and excavation methods when better methods are available. Innovative approaches to ground support such as slurry walls, tiebacks, grouting, and ground freezing will be promoted through workshops, design and construction guidelines, and by providing incentive for development of alternative designs.

The adoption of major developments such as precast liners or prefabricated structural members is a complex problem involving all of the factions of the highway tunnel industry. The inherent problems in promoting new techniques in a specialized field such as tunneling where each project is large-scale but isolated and unique, make adoption of new ideas a long-range process.

Symposium on Slurry Trench Walls

The Implementation Division sponsored a 2-day symposium on the use of slurry walls as part of the final structure in underground facilities. The symposium was held in Cambridge, Massachusetts on August 30 and 31, 1979. A field trip to the site of the Harvard Squart MBTA station construction was arranged for early registrants. Approximately 275 engineers from around the world were in attendance. A set of proceedings from the symposium was published in the first quarter of Fiscal Year 1981.

IRF Review of Slurry Wall Construction in Europe

The use of the slurry wall technique for underground construction is much more common in Europe than in the United States. The Federal Highway Administration (FHWA) is exploring the questions of why slurry walls are more common in Europe and what aspect of European practice could be adopted in the U.S. to promote the use of this cost-saving technique. In order to answer this question for FHWA the International Road Federation organized a 7-member study team to review the State-of-the-practice in various European countries. The team met with engineers and inspected construction sites in England, France, Italy, Germany, and Belgium and their report is scheduled to be published in early 1981.

Design Criteria for Permanent Ground Anchors

Ground anchors, also called tiebacks, are being considered as a viable solution to several different problems in highway construction including wall construction in highly developed urban areas and remedial slope stability projects. Several States are seriously considering use of ground anchors but lack the design expertise to investigate the feasibility of the anchors and then make or check detailed designs as proposed by contractors. A set of design criteria for permanent ground anchors would provide basis for determining the feasibility of ground anchors as a solution to a given problem and for estimating costs. The Offices of Research, Development, and Highway Operations are cooperating in an effort to develop design criteria to fill this need. Three firms, experienced in the design and construction of permanent ground anchors were engaged to provide three different approaches to rational design of the anchors and have submitted their final reports. The Office of Highway Operations will use this input to develop technical guidelines to be given to the States. A one-day seminar on design of permanent ground anchors was held November 6 in conjunction with the Southeast Geotechnical Engineers Meeting in Atlanta.

Symposium on Site Exploration in Soft Ground

A 3-day symposium on the use of in-situ techniques for site exploration in soft ground was held May 1 through 3, 1978, in Alexandria, Virginia, Expert speakers from the United States, Great Britian,

and France presented papers on the theory, operation, and application of various in-situ devices including self-boring pressuremeters. Approximately 125 engineers from the United States, Canada, Great Britian, and France attended the sessions. The symposium proceedings which include a definitive paper on the Standard Penetration Test by Dr. John Schmertmann, were published in the spring of 1980 and are now available from the U.S. Government Printing Office.

State of Stress in Soils

The final 2-volume report on Evaluation and Operating Procedures for the French Self-Boring Pressuremeters (PAF 68 and PAF 72) was distributed to the field in February 1980.

Seminar on Tunnel Instrumentation

A two-day seminar on instrumentation of highway tunnel construction was sponsored by the Implementation Division and held March 24-25, 1980 in New Orleans, Louisiana. Approximately 125 engineers and administrators attended the seminar which emphasized the practical aspects of an instrumentation program for monitoring deformations, stresses, etc., during construction of driven or cut-and-cover tunnels. Papers on case histories of actual projects were presented. A set of proceedings has been prepared and will be published in 1981.

Documentation of Slurry Wall Construction

The slurry wall method is a well established procedure for building subsurface walls prior to excavation for an underground facility. The method has been used routinely for years in Western Europe and other parts of the world for both private and public works construction. However, in the U.S., its use on public construction has generally been limited to a few cut-and-cover tunnel projects. It has not reached its potential for cost-effective and technically efficient use in smaller applications. Documentation of successful use of the method in projects of relatively small scope would

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provide impetus to wider use of the technique.

A potential site for documentation of slurry wall construction has been identified in Atlanta. The slurry wall method will be used to build a retaining wall for a depressed highway section. A contract is being negotiated with Michael Chi Associates to accomplish this task.

Workshop on Grouting Techniques

The use of grouting for ground support, ground water control and modification of soil properties is a developing art which has seen considerable advances in materials, equipment and techniques in recent years. Two significant factors in these recent advances have been the research sponsored by FHWA under FCP Project 5B and developments made by individual grouting specialty companies. A workshop is being planned to provide a forum for a critical review of these newest developments and to promote a widespread use of new materials and techniques.

WASTE AND SUBSTITUTE MATERIALS - William C. Besselievre

The short-term objective of the Waste Program is to encourage highway agencies to install experimental projects, through HP&R programs and task order contracts, utilizing various types of waste materials. From these experiences, pavement design parameters can be established and materials specifications can be formulated. The long-term objective is to have all highway agencies consider the use of waste materials in their construction programs, and these considerations should be based on sound engineering principles and the guidelines developed in the short-range programs.

The utilization of waste materials is of national concern, especially to the highway industry where the potential exists for using waste materials in large quantities.

The technology exists today to show and demonstrate that waste materials can be used successfully in highway construction. Some of these are rubber, incinerator residue, sulfur, fly ash, bottom ash, slag, building rubble, sewage sludge, and coal mine refuse. Various research studies being conducted by the highway community and industry, and pavement evaluation studies being supported by the Office of Development are programed to help solve this problem.

Fused Incinerator Residue

Pennsylvania's Department of Transportation (Penn DOT) final report on their field trial has been written. The report is being printed and will be disseminated in 1981.

SEA Field Trial--Lufkin, Texas

The draft interim report of the several-year evaluation has been reviewed and returned to TTI. A three-year extention has been negotiated.

SAS Field Trial -- Kenedy County, Texas

The final report on the 3-year evaluation is being written. The Bureau of Mines, the Sulphur Institute, Texas SDHPT, and TTI have agreed to a 3-year extension of the evaluation. Negotiations are underway for financing this time extension.

Incinerator Residue in Bituminous Base Construction

The Office of Research is managing the 3-year extension for obtaining long term information of performance on this pennsylvania project.

SEA - Field Trials

The Implementation Division accelerated its SEA efforts after the Office of Research's study program indicated that SEA could be a viable alternative to asphalt. SEA pavement construction has been completed in Arizona, Washington, Florida, Minnesota, Delaware, Maine, and at a New York Port Authority facility. An SEA pavement in Mississippi will be constructed in early 1981. Individual design and construction reports will be distributed with executive summaries during 1981. Long term monitoring of the trial construction will complete the Implementation Division's SEA activities. Region 15 will carry on the SEA trials through their demonstration program. NEEP 26 will monitor all SEA construction in the U.S.

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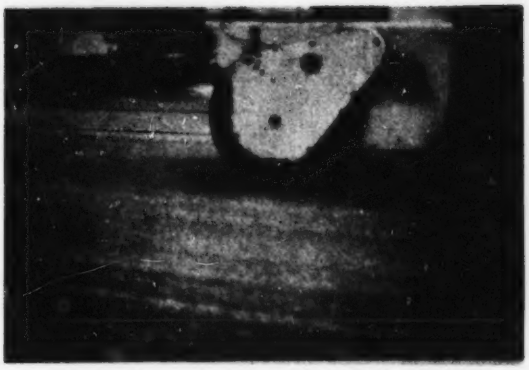
SULFLEX

A field trial program where short sections of pavement using modified sulphur (sulflex) as a substitute for asphalt binder is now underway. Construction has been completed in Texas, Nebraska, North Dakota, Pennsylvania, Florida, and Georgia. Construction in Arizona and Michigan will be completed in early 1981. A 2 year monitoring of pavement performance will follow. The Office of Research is managing the trial construction and evaluation. The Implementation Division provided the funds.



Problems have been encountered in drum mixers where less than the required percent of sulflex was added. A calibration program in Georgia was devised to correct this problem.

An interim consolidated report from these activities will be prepared in late 1981.

SEA State-of-the-Art Guidelines

This is a first-rate document. Publication and dissemination are expected in early 1981.

Modified Sulfur as a Joint Sealant

Southwest Research Institute was awarded the contract to try this material as a joint sealant. Results will be available in 1982.

Sulfur Visit to Canada for IRF

Planning is underway for a joint IRF/FHWA team visit to Canada to observe their sulfur program. The team will be made up of selected individuals from State, FHWA, and industry. The two week visit is scheduled for late spring.

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Engineering, Location and Design Group (HDV-21)

Edmund A. Hodgkins	- Group Chief	426-9211
Robert E Ellington	- Traffic Systems Development	-9211
David R. Gibson	- Traffic Systems Development	-9211
Kenneth E. Jones	- Environmental	-9205
Eric P. Munley	- Environmental, Highway Design and Traffic Control Devices	-9205
Mohan Pillay	- Pedestrian Safety and Roadway Safety	-9205
Richard A. Richter	- Pedestrian Safety and Roadway Safety	-9211
Juri Rau	- Energy Management	-9205
Michael E. Robinson	- Highway Design and Roadway Safety	-9211
Charles F. Stockfisch	- Traffic Systems Development	-9211
Robert D. Thomas	- Environmental and Hydraulics and Hydrology	-9205
Rudolph T. Umbs	- Roadway Safety	-9211
William G. Williams	- Highway Design and Traffic Control Devices	-9205
Robert C. Wood	- Hydraulics and Hydrology and Structures	-9205
Patricia J. Lema	- Support Staff	-9211
Debora Currington	- Support Staff	-9211

Environmental Program - Kenneth E. Jones
- Robert Thomas
- Eric Munley

Increased awareness in recent years of environmental impacts from transportation sources has prompted a Federal requirement for the construction of highway facilities which are compatible

with the environment. Consequently, transportation agencies had to acquire the skills and insights necessary to address environmental concerns. The transfer of technology by the Environmental Program has accelerated the process of education and use of state of the art techniques. The transfer process has been accomplished by a variety of means including training course development, environmental computer models, design guidelines, manuals and the use of audiovisual techniques. The desired results of these actions is the routine incorporation of environmental considerations into the design, location, operation, construction, and maintenance of highway facilities. Interested audiences include city and State highway and environmental engineers, managers, and public officials. Other Federal agencies participate in and benefit from the activities conducted under the Environmental Program.

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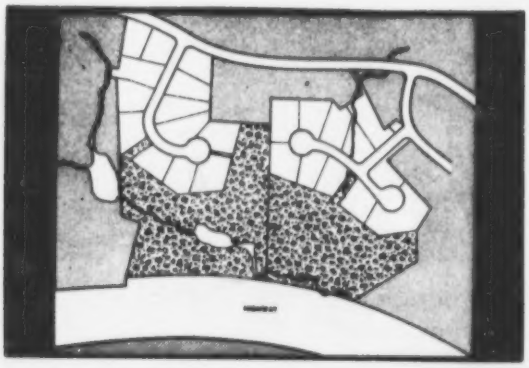
Highway Traffic Noise and Compatible Land Use Development and Control

A slide-tape presentation recently developed is designed to motivate local public officials to adopt ordinances or otherwise obtain administrative controls to ensure that land adjacent to major highways will be developed in a manner compatible with highway traffic noise. The presentation concentrates on the three-part approach to effective highway traffic noise control;



1. Source control
2. Highway planning and design
3. Land use planning and development control

The audience for which this presentation was developed is the local public official. Consequently, land use planning and development control is given major emphasis. This includes administrative and physical techniques for local officials and developers respectively and relationships to FHWA and HUD policies. The local official is shown what others are doing in their areas of responsibility as well as the local jurisdiction's alternatives.

Seventy-five copies of the slide-tape and script were recently received. The distribution plan will be developed by the Office of Environmental Policy (OEP) which managed the project. OEP has indicated the probable need for the presence of FHWA field personnel at showings of the slide-tape in order to expand upon the slide-tape message and respond to questions concerning FHWA policy. An announcement brochure may not be appropriate under these circumstances. Distribution should be effected by the end of calendar year 1980.

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Development of Texts and Courses for Fundamentals and Abatement, and Advanced Prediction and Abatement of Highway Traffic Noise

Prior to 1973, few personnel in the State highway departments or in the FHWA field offices had proper training or experience in dealing with highway traffic noise problems. FHWA developed a textbook and training course in 1973 to fill this need. The course was subsequently taught to over 1,500 people. However, much of the course became outdated and required revision. Further, the extensiveness of new technical knowledge of highway noise assessment indicated a need for both an updated basic course and an advanced course. An Implementation effort has developed pilot training courses, for basic and advanced highway noise. NHI is now sponsoring the presentation of the revised basic course. The pilot for the advanced course is scheduled for February 1981.

An Algorithm for Optimizing Noise Barrier Design

Noise barriers are coming into greater use as an effective means of limiting the impact of highway traffic noise. For a given set of noise reduction criteria there exists a large choice of materials and designs. Designs are normally based on estimates of what height, length, and placement will provide a desired degree of protection. In order to ensure construction of cost-effective barriers, an algorithm for optimizing the design variables is being developed under this effort. The algorithm will be exercised in conjunction with the FHWA Level II computer program STAMINA for highway traffic noise prediction. The algorithm will consider acoustic parameters (height, length, placement, degree of protection) as well as cost information (material costs, construction costs), and provide a means to assess the trade-offs of noise impact reduction and barrier cost. Distribution of the computer program and supporting documentation is expected in Summer 1981. The procedure for distribution will be coordinated with the proposed Demonstration Project No. 938, Noise Barrier Design Optimization. The Office of Engineering and Region 15 have tentatively agreed to handle distribution of the computer program. The documentation report will be distributed as an Implementation Package, used as a reference in the advanced noise training course, and act as the basic reference for the upcoming Demonstration Project.

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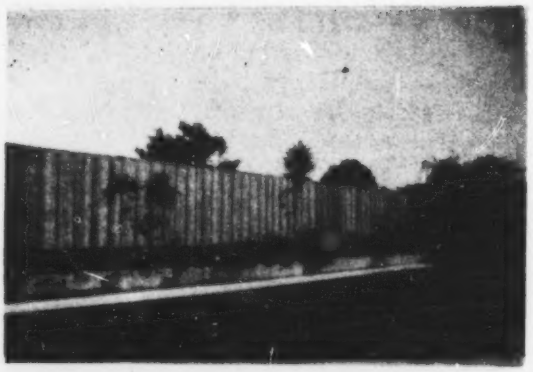
Evaluation of Highway Noise Mitigation Procedures



The study involves developing a manual which lists and discusses the advantages and disadvantages of various traffic noise mitigation measures including their cost effectiveness. Basic issues to be examined are:

1. What noise mitigation techniques are available to State highway agencies?

2. What constitutes a substantial change in noise levels?

3. What determines economic reasonableness when evaluating the cost of mitigation?

4. What factors should be considered when taking into account considerations of effects? Social? Economic? Environmental?

A reexamination of these issues in light of experience gained over the past several years is of timely interest. This reexamination will provide decision-makers with guidance which will aid them in making consistent decisions on mitigating traffic noise impacts. This effort is jointly sponsored by the Implementation Division, Environmental Division, and the Environmental Protection Agency. Results are expected to be available in Summer 1981.

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Interim Construction Guide for Highways and Wetlands

Highways and Wetlands

Interim Construction Guidelines

Recognizing the problems associated with constructing highways through wetlands, FHWA instituted a research program to develop mitigation procedures. In response to an immediate need for guidelines, an Implementation effort has produced a three-volume interim manual which compiles existing knowledge of highway impact on wetlands and presents highway development guidelines. Volume I provides interim procedural guidelines which may be used in various phases of highway development when they affect wetlands. Volume II discusses impact assessment and mitigation and enhancement measures in detail. Volume III contains a selected annotated bibliography of publications of particular interest to highway professionals responsible for highway activities in wetlands. Distribution of the three-volume manual is expected in January 1981.

Wetland Reconstruction

The purpose of this Implementation effort was to transfer wetland construction technology to the States of FHWA Region 3, and to New Jersey, Florida, and South Carolina. This transfer was initially accomplished by field and project review, on-site demonstration, and in-office briefings. The information has been organized in manual format to provide concepts, methods, and specifications for compensating unavoidable wetland establishment and enhancement. Distribution of the manual is expected in Summer 1981.

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Valuation of Wetlands

This is a joint Research and Development effort to develop manuals to assist highway agencies in properly assessing the functional and monetary values of wetlands. The first manual will provide guidelines and methodologies for ranking wetlands and assessing their functional values (services valued by man which are provided by wetlands such as flood control, wildlife habitat, etc.) The second manual will provide guidelines for assessing and purchasing wetlands by establishing fair market values. These guidelines will then permit the highway agency to replace wetlands unavoidably affected by highway location. Distribution is expected in early 1982.

Wildlife Considerations in Planning and Managing Highway Corridors

A manual is being developed under a jointly sponsored effort by the Implementation and Environmental Divisions and the Fish and Wildlife Service to provide information on how to better manage highway corridors to enhance wildlife resources. The manual will be addressed primarily to Federal and State highway department environmental specialists and their consultants with a background in biological sciences. The manual will provide measures for determining and predicting environmental effects of various highway activities on wildlife and evaluating different management strategies for roadside rights of way. Distribution of the manual is expected in Winter 1981.

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Roadside Stabilization and Revegetation Under Semiarid Climatic Conditions

The Montana Department of Highways, using HP&R funds, contracted with the Montana Agricultural Experiment Station over the past 8 years to and develop improved methods of reducing the cost of roadside maintenance, controlling erosion and establishing self-sustaining stands of grasses, legumes, shrubs, and trees, all related to semiarid climatic conditions. During the 8-year period, numerous studies concerning soil stabilization, revegetation, and maintenance were completed on new interstate highway roadsides. Research was concentrated on determining methods of efficiently stabilizing soil to prevent erosion and create a desirable seedbed. Studies also concentrated on developing reliable yet economical methods of establishing permanent vegetation. The research developed and evaluated several new techniques which demonstrate potential application throughout sections of the nation on roadsides and other disturbed areas. The objective of the Implementation Division's involvement is to effectively illustrate the benefits of these new developments by producing two slide-tape presentations. The presentations are expected to be available in Spring 1981.

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Bridge Esthetics

The contract is underway for the preparation of a reference manual on esthetic design of highway bridges. The basic concept is to relate principles of architectural design to specific problems of the highway bridge designer, enabling the designer to integrate visual considerations into the design processes. The type of bridge which this manual is concerned with is the kind which would not normally involve an architect, but would be wholly designed by an engineer. Distribution of the manual is expected in Spring 1981.

Energy Consumption of Surface Transportation Projects, Methodology and Manual

A contract was begun in September 1979, to develop a methodology to assess the energy consumption impacts of surface transportation projects. A guide or checklist type of manual will be developed to allow State transportation agencies to assess in their project Environmental Impact Statement the energy impact which their proposed project will have. An initial draft of the manual was found to be substantially inadequate. The ability of the contractor to satisfactorily respond to the problem is questionable. As a result, an estimate of the date of availability of the final product is not possible until further progress is made.

Energy Sourcebook for Highway Engineers

The Implementation Division has prepared a guide entitled, "Highway Engineers Guide to Alternative Energy Sources and Applications," FHWA-TS-80-212, which identifies alternative energy sources and their applications. This project compiled information from various sources on the energy requirements of highway application and determined which applications of alternative energy sources were feasible, practical, and desirable. This was published as a Technology Sharing Report in March 1980.

Safety Rest Area Promotion and Training Course Development

The Implementation Division, in coordination with the Office of Engineering, has developed a series of projects concerning safety rest areas. The projects are part of a Safety Rest Area program which consists of five modules:

Module 1 - Promotional Presentation

Module 2 - Planning, Location and Design

Module 3 - Water Supply and Wastewater Treatment

Module 4 - Operation and Maintenance

Module 5 - Motorists Information Services

Module 1 was prepared and distributed by the FHWA's Landscape Branch and includes promotional material which documents the necessity and usage of safety rest areas as viewed by various highway user groups.

Modules 2, 3, and 4 were developed as training courses which can be used by State highway departments to update their safety rest area program. The Minnesota DOT recently completed contract work for Module 2 and has developed a manual covering the essential principles in planning, locating, designing and upgrading safety rest areas. The State has also prepared an executive summary slide presentation entitled "Safety Rest Areas - A New Emphasis" which will be distributed with the manual in February 1981. Module 3, a training course covering the basic principles and design procedures for water supply and wastewater treatment systems,is currently available through the National Highway Institute.

The Arizona DOT is performing work for module 4 which will present practical guidelines and management techniques for effective operation and maintenance. Two pilot workshops have been completed and distribution of the manual is planned during Summer 1981. Module 5 was produced by the Florida Department of transportation. An illustrated booklet and a slide presentation have been prepared which demonstrate current design concepts in use by highway agencies for providing informational services at safety rest areas. Distribution is anticipated during early 1981.

BEST DOCUMENT AVAILABLE

Highway Design Program - William L. Williams
- Michael Robinson
- Eric Munley

The objective of the highway design program area is to identify, evaluate, and facilitate, the application of usable research and development results. This Implementation Program covers a wide range of subject areas relating to the location and design of highways. These include optimization of geometric criteria, corrective geometry, utilization of computerized design, remote sensing exploration techniques, emergency escape ramp methods, and capacity analysis procedures.

Outputs from this program area will primarily be procedures, both manual and automated, rather than material products. Implementation Packages will generally consist of design guidelines, user manuals, handbooks, slide-tape packages, motion pictures, and computer programs. Preparation of the Implementation Packages may be accomplished with the FHWA Washington Office or field elements, by utilizing the services and expertise of State highway organizations, or through contracts with public or private organizations.

Operational Remote Sensing Techniques for Transportation

A workshop has been developed that is aimed at training personnel primarily from State and local transportation agencies. This development consists of a 3-day workshop which covers all remote sensing techniques utilizing commercially available airborne instrumentation. Data handling methods are also covered. Four pilot workshops have been conducted. The course is available and will be presented in the FHWA regions during 1981 by the National Highway Institute. It is anticipated that the course will be offered 5 or 6 times each year for the next 3 years.

BEST DOCUMENT AVAILABLE

Handbook on Methods of Subsurface Void Detection

Many miles of our superhighways traverse that part of the land surface characterized by a phenomenon known as Karst terrain, better known as areas containing numerous sink holes. A good deal of research and experimental work has been done in terms of developing techniques for void detection. An Implementation Package on subsurface void detection has been developed. This project will create a compendium on methods for detecting subsurface cavities which will be valuable to highway planning, location and design engineers. A draft Implementation Package has been prepared and it will be published during the early part of 1981.

Handbook on applications of earth resistivity methods for detection of subterranean voids

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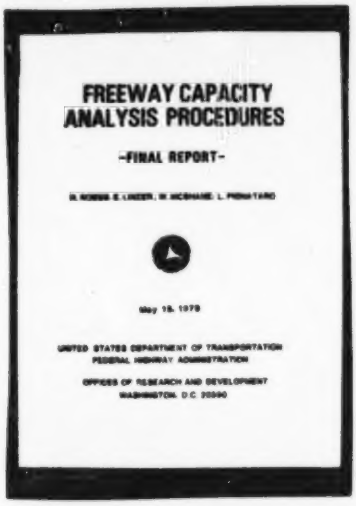
Freeway Capacity Analysis Procedure

In conjunction with a multi-agency effort to update the 1965 Highway Capacity Manual, a project is underway to revise the section of the manual dealing with freeway capacity analysis. New tentative freeway capacity procedures were published in Transportation Research Circular, Number 212, January 1980.



Photolog Measuring Techniques

The purpose of this development effort is to find a practical method for obtaining real-space dimensions from measurements taken directly from photolog photographs. This work includes the development of an operational computer program and the preparation of a users manual. Work is scheduled to begin in March 1981.

BEST DOCUMENT AVAILABLE

Techniques for the Control of Access to Highways and Streets Other than Freeways

The objective of this project is to assist highway engineers in achieving maximum safety and operational efficiency of streets and highways through improved access control measures. To accomplish this objective, a training course will be developed.

A contractor has been selected and work began in September. The contractor will develop a student textbook, instructors manual, and a visual aid package. It is anticipated that the course will be available in the fall of 1981.

High Occupancy Vehicle Facility Development and Enforcement

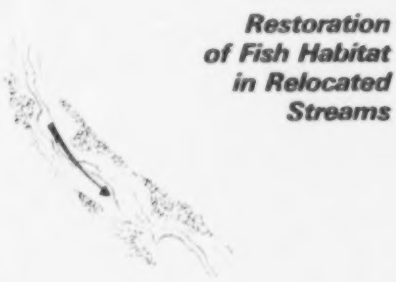
A course has been developed which presents a general review of the types of High Occupancy Facilities (HOV) constructed to date. The course will emphasize the methods used to identify, select, design and implement HOV treatments. This course was based on work done by the Office of Research and is currently available through the National Highway Institute.

High Occupancy Vehicle Facility Development, Operation and Enforcement

BEST DOCUMENT AVAILABLE

Restoration of Fish Habitat in Relocated Streams

The purpose of this manual is to describe proven methods that emulate the natural process in stream development. Particular emphasis is placed on the restoration of the fish habitat. This manual is currently available as Implementation Package 79-3.



Geometric Design of Resurfacing, Restoration and Rehabilitation Projects (RRR)

A training course will be developed to provide guidance on the proper geometric design criteria to be used on "RRR" projects. The training will include the underlying reasoning on which the geometric design elements are based, safety relationships, evaluation of alternatives, and case studies. An RFP has been prepared and it is anticipated that work will begin in February 1981.

Resoruces for Educating Truck Drivers about Truck Escape Ramps

An HPR contract is underway with West Virginia University to prepare a booklet and audio-visual presentation to show truck drivers the advantages of using escape ramps over attempting to "ride-out" the grade in a runaway situation.

BEST DOCUMENT AVAILABLE

Pedestrian Safety Program - Richard A. Richter

The objective of the pedestrian safety program is to identify, develop, evaluate, and facilitate the application of usable research and development results relating to pedestrian and bicyclist safety.

This implementation program is intended to achieve the above stated objective through the development of planning and design aids. These include guidelines for physical separation of pedestrians and vehicles, guidelines for planning and designing overpasses, underpasses, malls and skyways; model safety programs for application of such pedestrian accident countermeasures as median barriers and mid-block crosswalks, guidelines for the location, design, and construction of bikeways, investigations of the needs of elderly and handicapped pedestrians for free access on sidewalks, pathways and streets and recommendations for the physical features required and for the locations for those features.

The primary outputs from this program area are procedures rather than material products. Most implementation packages will generally consist of design guidelines and/or criteria, user manuals, handbooks, slide-tape packages, and motion pictures.

Certain research outputs, however, require either field demonstration and/or the initiation of experimental projects for field evaluation to ensure that promising outputs are promoted.

Pedestrian Accident Countermeasures in Puerto Rico

This project is to apply the commonly used types of pedestrian safety features to locations in Puerto Rico where there are heavy concentrations of pedestrian - motor vehicle accidents. Improvement locations are to be selected so that there is a reasonable chance that a measurable effect from the improvement can be observed.

Eleven improvement locations were included in the Task B countermeasures plan. The plan, submitted April 3 is satisfactory and work is proceeding with development of the Task C Evaluation Plan. A new Principal Investigator, Mr. Persecto Ocasio has been named. Implementation plans for the physical improvements are being prepared.

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Barrier Free Design of Highway Related Facilities

This project produced an analysis procedure capable of identifying pedestrian travel patterns for elderly and handicapped pedestrians. Using this procedure, travel patterns can be projected and improvements scheduled to allow maximum benefit from available funds.

The user manual on this project, FHWA IP 80-8, "Development of Priority Accessible Networks" was distributed in February 1980. The slide tape describing the "Development of Priority Accessible Network" manual has been completed and was distributed in October, 1980. A follow on activity is applying the provisions of the user manual in urban jurisdictions.

BEST DOCUMENT AVAILABLE

Safe Pedestrian Facilities

Contracts have been awarded to Boulder, Colorado, San Francisco, New York and Baltimore for applications of the Model Pedestrian Safety Program.

These cities will implement pedestrian improvements in a selected pedestrian corridor or network and evaluate the effect of the improvements on pedestrian operations and safety.

Manual on the Design of Over and Under Passes for Pedestrians and Bicycles

This project is to provide guidance to planners and designers of pedestrian and bicycle crossings, both for structural and non-structural solutions. It is to be based on an Office of Research study of a group of 71 crossing locations on which detailed case studies have been prepared. The resultant manual is expected to address (1) determination of the crossing problem, (2) finding the desired location for the crossings, (3) the desirable features of the ends and approaches to the crossing structure, and (4) the determination of the structure design details.

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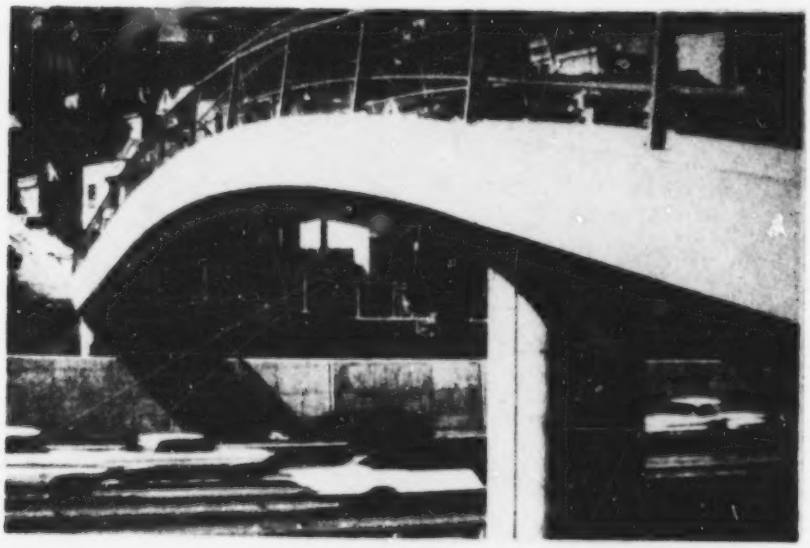
This work is being done as part of a research contract awarded to the Georgia Institute of Technology. The current research relates only to the elderly and handicapped pedestrian, and additional support may be needed to develop the bicycle aspects of the manual. The project is due to be completed in early 1982.



Synthesis Report on Pedestrian and Bicycle Publications

Critical issues involved in providing safe and effective pedestrian and bicycle facilities were identified at the start of this project, to serve as a focus for reviewing the available literature. It is expected the final report on this project will serve as a useful data source for any one involved in pedestrian or bicycle programs. The project has a projected completion date of March 1981.

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Low Cost Measures of Enhance Bicycle Travel

In many cases, minor improvements to existing highway facilities can provide a travel network for bicycles which is highly effective and safe. Usually the cost is prohibitive to construct separate facilities for bicycles so that the bicyclist has access on a par with that provided for motor vehicles. Minor modifications can allow safe joint usage by several modes of travel and allow easy bicycle movement between various types of facilities. These modifications and additions can often be made at low cost and can enhance the safety of facilities, being utilized by bicyclists.

Many examples of low cost improvements exist throughout the country. This project would seek to identify such improvements by contacting Bicycle Program Coordinators in nine jurisdictions. The information obtained would be cataloged according to problems solved, situations creating problems, and other categories which allow a potential user to search and identify case study examples of typical bicycle facility problems. A reference manual would be produced as a final product.

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Roadway Safety Program - Richard A. Richter
- Rudolph M. Umbs
- Michael Robinson

The objective of the roadway safety program area is to identify, develop, evaluate, and facilitate the application of usable research and development results relating to roadway safety. Items or findings to be implemented are those which will reduce the crash severity of errant vehicles with hazardous objects in the road environment. Hazardous objects include: signs, gore areas, bridge piers, roadside slopes, highway lighting, curbing, utility poles and other similar objects. In addition, this area is concerned with (1) design policies and standards intended to provide safer highways and roads, (2) highway safety improvement programming techniques, and (3) evaluation of completed safety improvement projects.

The implementable items in this area of concern are both material products and engineering processes or procedures. In the case of implementable engineering processes, the Implementation Package will generally consist of design guidelines or criteria, procedural guides, handbooks, and training curriculums' For material products, the Implementation Package will generally consist of design specifications, installation procedures, and motion pictures. In some instances, implementation will be advanced through experimental and demonstration projects.

Highway Safety Improvement Program - Manual and Course

A directive entitled "Highway Safety Improvement Program" (FHPM 8-2-3) was developed by FHWA. The purpose of this directive is to set forth policy for development and implementation of a comprehensive highway safety improvement program in each State. A user's manual and 3 1/2-day training course has been developed based on this directive. This effort is entitled "Highway Safety Improvement Program." The manual and course recommend general procedural requirements of the improvement program regarding the (1) planning, (2) implementation, and (3) evaluation components as described in FHPM 8-2-3. Pilot presentations were held in September and October 1980. The training course is available through the National Highway Institute.

Highway Safety Improvement Program (FHPM 8-2-3)

- Planning
- Implementation
- Evaluation

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Highway Safety Evaluation - Manual and Course

More detailed manuals and training have been prepared for the planning, implementation and evaluation components because the Highway Safety Improvement Program manual and course will provide only general requirements.

One component is entitled "Evaluation of Highway Safety Projects. This is a training course and procedural guide for project evaluation. The course and guide describe a procedure for the evaluation of highway safety projects using accident analysis to substantiate project effectiveness. The course and guide are aimed at local and State safety personnel responsible for managing and/or conducting project evaluations.

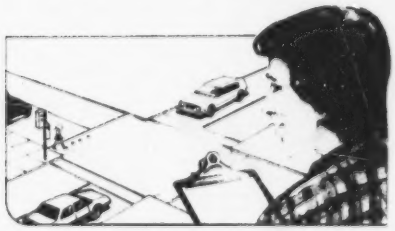
Training courses for State and local jurisdictions were conducted by FHWA field safety personnel during 1980. The procedural guide, instructor's guide, and visual aids are available through the Office of Highway Safety.

In September 1977, representatives of 24 States attended a pilot training course using an earlier version of the project evaluation procedure. Since that time, the States have engaged in a 3-year field test of the procedure for five of their safety improvements.

The field test ended December 1980. The States will be providing copies of the final evaluation reports to the Implementation Division.

The above manual and course, "Evaluation of Highway Safety Projects," have been expanded to include program and administrative evaluations and evaluations using non-accident measures of effectiveness. This course is entitled "Highway Safety Evaluation." Pilot presentations were held in October and December, 1980. The course will be available through the National Highway Institute.

Highway Safety Evaluation



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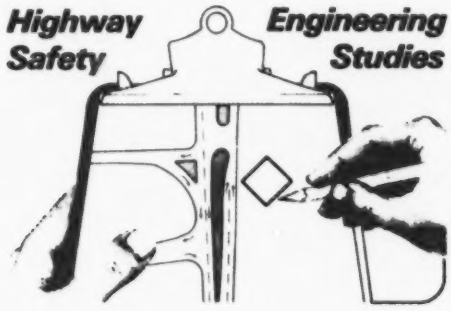
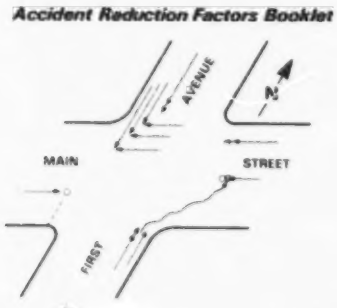
Highway Safety Engineering Studies - Manual and Course

Another component in the Highway Safety Improvement Program is Highway Safety Engineering Studies. A user manual and course are being developed for this. They will describe the process for analyzing hazardous locations to determine the most appropriate countermeasures. This will include step-by-step discussions of various highway safety engineering study procedures and techniques. The two pilot courses will be conducted in January and February 1981. The manual and course are aimed at State and local highway agency personnel involved in traffic operations and/or highway safety. The course will be available through the National Highway Institute in mid 1981.



Accident Reduction Factors Booklet

The estimation of the effect a proposed highway safety countermeasure will have on the accident experience is referred to as the accident reduction factor. Accident reduction factors vary for different accident situations, countermeasures and site conditions. Unfortunately only a few highway agencies have developed and recorded accident reduction factors. Therefore, a nationwide compilation using research and multi-State experience is being developed. This compilation will be documented in a booklet which will be available in March 1981.



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Functional Requirements of Highway Safety Features - Handbook and Course

The 1977 FHWA Safety Review noted that some highway safety features were being improperly applied, modified, and maintained. As a result, a concentrated effort was initiated to inform State and local personnel involved in highway construction, operations, and maintenance of the functional requirements of highway safety features. This effort consists of a training course with a handbook and 10 slide-tape presentations. The 10 slide-tape presentations are for various safety features and are capable of being represented on an individual basis or as an entire training course. Pilot presentations were conducted in May and June 1980. Because of an expressed need to make the course available as soon as possible, additional courses were presented starting in August 1980. The course and 10 slide tapes are now available through the National Highway Institute.

Highway Safety Program Orientation

The management of Federal funds being utilized for highway safety programs requires a wide variety of skills, knowledges, and abilities (SKA). The persons assigned to such management positions in Federal Highway Administration Division Offices in each State often come from positions where they have not had the opportunity to develop all the skills, knowledges, and abilities needed and it takes them considerable time to develop and acquire those SKA's. To accelerate the development of newly assigned Highway Safety Program Engineers in FHWA Division Offices, a training package is being developed. This package will be a self-instructional workbook and cassette tapes. It will be available in early 1982.

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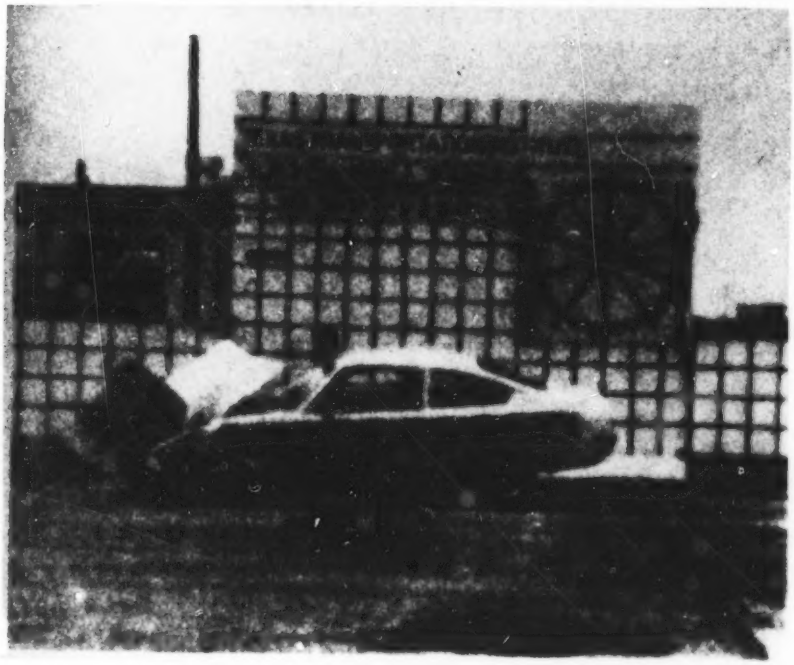
Cost Effectiveness of Small Highway Sign Supports

This project involved the development of a comprehensive procedural manual on the selection, construction, and maintenance of small highway sign support systems, through a systematic evaluation of both "crashworthiness" and cost effectiveness of current and potential sign support systems.

The study has produced six separate reports and a documentary movie. These reports are (1) "State-of-the-Practice in Supports for Small Highway Signs" (2) "Full Scale Crash Tests of Small Highway Sign Supports", (3) "Guidelines for Selecting a Cost Effective Small Highway Sign Support System", (4) "Crash Test of Rural Mail Box Installations", (5) "Crash Tests of Single Post Sign Installations Using Subcompact Automobiles," and (6) "Cost Effectiveness of Small Highway Sign Supports - A Summary Report". The film and Executive Report summarize the results of the study and promote the guidelines for selecting small sign support systems.

The six reports developed under this contract has been completed and distributed.



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Captive Column Crash Tests

A new type of structural support was tested in this project. It consists of three rods held apart by a wooden core and anchored by winding with long wire strands. A fiberglass cover encloses the structural elements.

The film and final report have been received on this project, and the project completed. A minimum distribution of the report is planned.

Guardrail on Slopes Film

The research which preceeded this film production was to show the effects of guardrail located on roadway embankment side slopes.

A preliminary film has been received and reviewed. Final testing on the guardrail is now being planned after which the film will be completed. It is expected the research will be terminated prior to the development of a completely satisfactory set of recommendations for guardrail on sloping terrain. Additional testing will therefore be required before resolving this issue.

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Safety Modifications of Turned-down Guardrail Terminals

Vehicle accidents involving guardrail terminals have frequently been high severity types of accidents. One of the commonly used types of terminals is the turned down terminal which causes ramping and overturning of the impacting vehicles.

This implementation manual will be developed as one phase of a research project. The initial testing has not produced a completely successful design. Some additional testing is now required before the manual preparation will be able to begin.

Tire and Pipe Attenuator Manual

A manual has been prepared from an Office of Research investigation into the construction of impact attenuators from scrap materials. There is a problem involving the patent rights for one of the impact attenuator designs which needs to be resolved before the distribution can be made.

BEST DOCUMENT AVAILABLE

Prompt Utilization of Safety for Highways Impact Attenuator Analysis

Two projects have been conducted to evaluate the effectiveness of installed impact attenuators and bridge barriers. This contract investigated impact attenuators through the collection of data at 50 locations.

The first phase final report was submitted and determined to be inadequate to serve as a basis for performing the second stage. The project will be terminated after completion of work on the first phase.

Prompt Utilization of Safety for Highways - Bridge Railing Upgrading Analysis

This project, similar to the one involving impact attenuators, was performed at 50 locations where bridge railing upgrading had been performed.

The 1st phase draft report has been received. A decision has also been made on this project not to continue with the second phase.

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A Guide to Standardized Highway Drainage Products

Items of highway hardware supplied by different manufacturers can have sufficient variation in their fabrication to prohibit the interchange of parts. This requires highway agencies to have a separate supply of parts for each manufacturers product. Because of this situation, standardization is an important element in the fabrication and installation of highway hardware items.

An AASHTO-ARTBA-AGC-FHWA Joint Committee (13) has been established to review highway drainage products to determine their suitability for standardization. The results of the Committee's investigation will be prepared in preliminary draft form, including suggested drawings and explanatory material. This project is to use the draft materials prepared by the Joint Committee and develop the final report in reproducible form. Procurement action is pending.

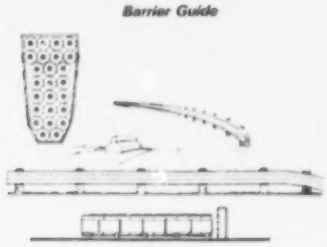
Self-Restoring Barrier (SERB) Film

The effectiveness of highway roadside barrier is dependent upon the maintenance of the barrier system integrity at all times. For most types of barriers, particularly the energy absorbing (deflecting) types, a vehicle involvement with the barrier means that the barrier is not effective until maintenance forces make the necessary repairs.

A new type of barrier system called the SERB (Self-Restoring Barrier) has been developed by the Office of Research to combine most of the features desired in a barrier system. It provides a forgiving (deflecting) surface for smaller vehicles, absorbs most impacts without significant damage, and quickly restores itself to a position capable of responding to another vehicle impact. Also, it maintains a straight alignment after impact and preserves the esthetic qualities of the highway.

The objective of this project is to prepare a 20-minute movie using the crash test film footage available form the related research contract. The movie will illustrate the various features of the SERB system and verify its performance when impacted by a variety of vehicle types. The film is a result of in-house cooperative efforts by the Office of Highway Safety, the Offices of Research and Development and the Publications Visual Aids Branch.

Selecting, Locating, and Designing Traffic Barriers

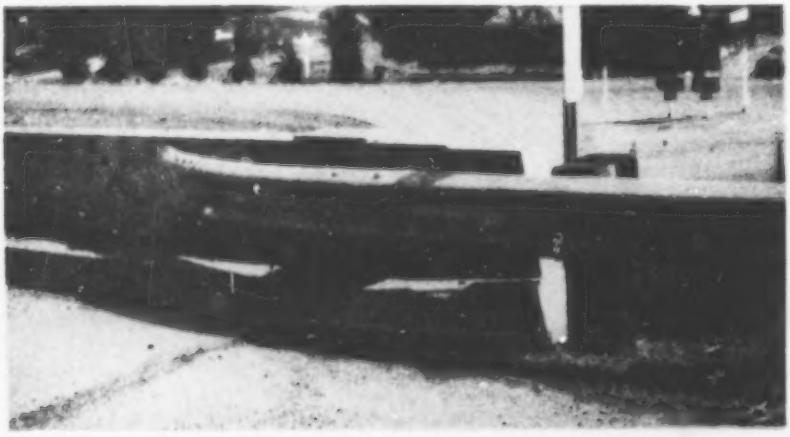


The contract was awarded to Texas A&M Research Foundation for the preparation of a training course to present the procedures included in the 1977 AASHTO Barrier Guide. Two pilot presentations were conducted. One in Washington, D.C. on January 16, 17, and 18, 1980, and the other in Fort Worth, Texas on January 30 and 31, 1980. The contract was completed on August 12, 1980.

Bridge Rail Retrofit Systems Film

The objective of this effort is to develop a 16 mm movie on the successful retrofit systems revealed in research report FHWA-RD-77-40, "Upgrading Safety Performance in Retrofitting Traffic Railing Systems.: The film will depict the three variations of the tubular thrie beam retrofit concept along with a precast concrete parapet concept and an extruded "bullet-nose" aluminum railing concept. This effort was submitted to Contracts and Procurement on February 31, 1980, and will be a modification to contract DOT-FH-11-9462, "Bridge Rail Retrofit for Curved Structures."

A Cost-Effectiveness Procedure for Guardrail Evaluation



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The objective of this project is to develop an easy-to-use manual that describes the use of a small computer program. The computer program can be used for a cost-effectiveness analysis of the most commonly found guardrail types (standard and non-standard) with alternative types being considered appropriate for upgrading. Task Orders with two States will be negotiated to field test the procedures.

The Collection of Work Zone Accident Data

Based on the collective practices observed in nine States, acomposite procedure for collecting data on traffic accidents occuring in construction (work) zones has been developed. A manual will be prepared under this project to help States in up-grading their own procedures. During a second phase of the project, the collection procedure will be validated by trail in selected States. The project is to be completed by October 1981.

Collection of Work Zone Accident Data

BEST DOCUMENT AVAILABLE

Hydraulics and Hydrology Program - Robert C. Wood
- Robert Thomas

The primary objective of the Hydraulics and Hydrology Program is to identify, evaluate and develop usable research results that will protect the highway system from hazards attributed to flooding. This is accomplished by the improved design of drainage structures and stream crossings.

The primary source of input for the program comes from FHWA's own research efforts under Federally Coordinated Program (FCP Project 5H) - Protection of the Highway System From Hazards Attributed to Flooding.

The major research efforts under FCP Project 5H are included in four tasks; 1. Prevention of Damage due to Scour, Erosion, Sedimentation and Debris; 2. Design Methods for Urban Highway Storm Drainage and for Effects of Urbanization; 3. Improved Design Methods for Highway Drainage Structures; and 4. Hydraulic Problems Affecting Stream Crossings.

Implementation items in the area of hydraulics and hydrology usually involve concepts in hydrologic design, hydraulics of waterways, or the design of hydraulic structures. There is a continuous need for implementation items which are developed to address typical problems faced by State drainage engineers. These items are packaged in an appropriate form for their most effective use.

Underground Disposal of Storm Water Runoff

The California Department of Transportation has completed the preparation of a manual to assist in the planning and design of infiltration drainage systems in highway applications. Infiltration drainage is an alternate method of storm water disposal in areas where the soils consist of well-drained materials. Water resources planners and drainage design engineers are showing considerable interest in this method because of the distinct advantages which it offers. The manual describes procedures for evaluating the feasibility for using an infiltration drainage system and illustrates ways the system can be effectively and economically incorporated into a highway drainage scheme. The manual is currently available through the Implementation Division and the Government Printing Office.

Design of Urban Highway Drainage: The State of the Art

Work has been completed on the preparation of a comprehensive urban storm drainage manual to provide highway drainage engineers with a concise up-to-date assembly of useful design information. Step-by-step design procedures, useful design charts, tables, and other design aids are included. This manual will be helpful to the various State highway departments, cities, and counties in formulating drainage design policies and for use in the actual design of storm drainage systems. The manual is currently available through the Implementation Division and the Government Printing Office.

Hydraulic Design of Bridges with Risk Analysis

This FHWA sponsored study is to demonstrate the implementation of design requirements for encroachments on flood plains. A simplified methodology is included which can be used to assess the risk of economic loss caused by flooding for various design alterntives and flood frequencies. The report is intended to guide highway designers in selecting bridge configurations which provide adequate flood protection and minimize overall economic costs. Copies of the report are available through the National Technical Information Service.

Manual for the Design of Storm Water Pumping Stations for Highway Facilities

William Lever and Associates, Long Beach, California, are developing a much needed manual for the design of storm water pumping stations for highway drainage applications. The manual is to contain sufficient information to enable the engineer to evaluate the options available and select a design which is suitable for a particular application. The manual will be aimed at achieving greater standardization in pumping station installations and promote the use of economical and proven designs. Publication of the manual is anticipated in FY 1981.

Hydraulic Flow Resistance Factors for Corrugated Metal Conduits

The FHWA report entitled "Hydraulic Flow Resistance Factors for Corrugated Metal Conduits" by J. M. Normann and H. G. Bossy, 1970, is based on experimental investigations of resistance factors in annular corrugated metal conduits with 2-2/3 by 1/2 inch corrugations. This information was used to estimate resistance factors for other corrugation sizes.

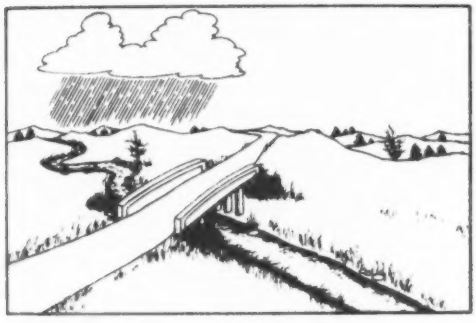
Since the publication of this report, the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, has conducted tests on both annular and helical corrugated metal pipe with various other pitch to depth ratios. These test results will allow an expansion of the present publication and provide a basis for improving the resistance factor estimates presently given in the FHWA report. J. M. Normann, one of the two original authors, has completed a contract to revise the report. The report is currently available through the Government Printing Office.

Hydrology for Transportation Engineers

This contract was performed by the Colorado State University and is now complete. The project resulted in a complete training course which covers the basic hydrologic principles, procedures, and analytical methods that are applicable to highway drainage design. A reference manual was distributed during January 1980 and training materials were printed. The manual is currently available through the Government Printing Office. Self-instructional video tapes are now available from the National Highway Institute. The NHI will also schedule future training sessions.

FHWA-IP-80-1

HYDROLOGY FOR TRANSPORTATION ENGINEERS



U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration
Offices of Research and Development
Implementation Division (HDV-21)

January 1980

Wyoming Culvert Design Program

The Wyoming Highway Department has completed the development of a computerized culvert design system. The program documentation has been completed and will be distributed on a national basis as a Technology Sharing report. Printing and distribution will occur in early FY 1981.

BEST DOCUMENT AVAILABLE

Countermeasures for Hydraulic Problems at Bridges

The U.S. Geological Survey has prepared a slide tape presentation which introduces the basic elements of a recently completed research report. The report (FHWA-RD-78-162 and 163) contains guidelines to assist design, maintenance, and construction engineers in selecting measures that can be used to reduce bridge losses and damage attributable to scour and bank erosion. The slide presentation depicts stream-related hazards and documents the performance of various countermeasures at actual sites. Distribution of the slide tape was completed in February 1980 and it is available on a loan basis from the National Highway Institute.

Example Standard Plans for Improved Inlets

The FHWA has recommended the use of improved inlets for culverts for many years through research reports and demonstration projects. While these efforts have encouraged the hydraulic design of improved inlets, use of the inlets has not become standard practice in most highway departments. An implementation effort will prepare example standard plans for improved inlets based on specific design criteria and will organize and classify this material for easy reference by highway design personnel. The contractor has completed a review of the literature and has submitted an annotated bibliography. A summary of current design procedures for the structural design of culverts and improved inlets has also been submitted and reviewed by the steering committee. Initial work in developing a complete design manual and draft standard plans is now underway.

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Design Manual for Bicycle-Safe Grate Inlets

The primary effort in the preparation of this design guide will be to condense the material presented in several FHWA research reports developed by the U.S. Bureau of Reclamation on grate inlets. This will include development of design procedures for three grate designs tested and found to be bicycle safe and hydraulically efficient. The contractor, Mr. Fred Chang, has completed a computer program to calculate efficiency and gutter flow in the sump condition for the three selected grates. Programming instructions for the desk top HP67/97 and TI58/59 calculators to perform the same computations are included in the design manual. Publication and distribution of the manual is planned during 1981.

Loyalsock Creek Film

Identification of hydraulic problems and the methods of achieving practical solutions are valuable to engineers across the country. The film to be developed in this project will document the hydraulic problem at the Loyalsock Creek in Pennsylvania and provide insight into the methods of analysis and implementation of a practical solution by using a hydraulic modeling technique. A contract with the Pennsylvania Department of Transportation was awarded in May 1980.

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Traffic Control Devices Program - William L. Williams
- Eric Munley

The objective of the traffic control device program area is to identify, develop, evaluate, and facilitate the application of usable research and development results relating to traffic engineering.

This program covers the broad area of traffic engineering as related to safe and efficient operation of the Nation's street and highway network. The program deals with the fairly new concept of traffic management with a view toward integration of all highway transportation modes into a coordinated system including all aspects such as warrants, regulatory measures, and advanced operational procedures and techniques.

The broad range of FCP research outputs emanating from this program area requires the application of a variety of implementation approaches. Interested audiences may include legislative bodies, law enforcement officials and the general public as well as city and State engineers and managers. User packages will vary from documentation in the form of simple rulings on the use of a traffic control device to comprehensive handbooks and specifications for advanced freeway corridor control systems.

On-Street Parking Guidelines

In September 1979, the Office of Research published report RD-79-76 entitled "Safety Aspects of Curb Parking". Subsequently, an implementation project was initiated to develop guidelines that can be used by engineers to determine acceptable site specific on-street parking arrangements, and to prepare a user's manual and a slide-tape presentation based on these guidelines. A prospectus was completed and it is anticipated that work will begin in February of 1981.

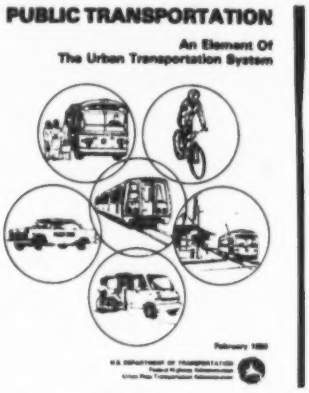
Railroad Grade Crossing - Law Review

This project will review and catalog all Federal, State and local laws dealing with railroad grade crossings. The objective is to develop a single source, easy to use, cross indexed, reference document containing all laws and regulations applying to any class of rail-highway grade crossing. This project is sponsored jointly by the Federal Railroad Administration and the Federal Highway Administration. The Association of American Railroads is conducting this study in cooperation with Kansas State University.

Public Transportation

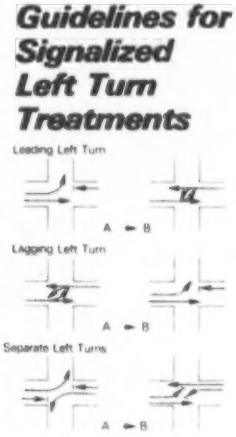
The objective of this course is to provide training on public transportation to individuals transitioning from predominately highway responsibilities to new public transportation responsibilities. This course was developed jointly by the FHWA and the Urban Mass Transportation Administration.

The course has been given over 40 times. The course textbook has been published as technology sharing report FHWA-TS-80-211.



Guidelines for Signalized Left-Turn Treatments

The safety and operation of a signalized intersection can be significantly affected by the use of signalized left-turn lanes, and through the use of a variety of left-signal phasing arrangements. Easy-to-use guidelines are needed to help the traffic engineer design cost-effective signal installations that minimize delay and at the same time enhance intersection safety. The objective of this project is to develop criteria that can be used by the engineer to determine the "best" left-turn signal treatment for signalized intersections. The contractor has completed a "Monograph of Usable Results" for left-turn treatments. The final guidelines will be submitted in January 1981.



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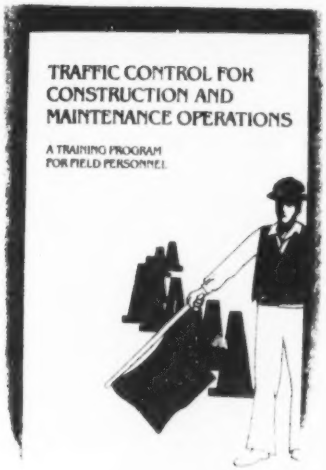
Operating Guide for Part VI "Traffic Controls for Street and Highway Construction and Maintenance Operations of the Uniform Manual

An operating guide to be used with Part VI of the Uniform Manual has been completed. The operating guide is intended to help the job site foreman apply the National Standards to a specific situation. The guide has been published by the Office of Traffic Operations as "Work Zone Traffic Control - Standards and Guidelines." The operating guide has also been incorporated into the Institute of Transportation Engineers (ITE) training course titled "Traffic Control for Construction and Maintenance Operations - a Training Program for Field Personnel."



Traffic Control Devices Handbook

The present Traffic Control Devices Handbook was prepared by the National Advisory Committee on Uniform Traffic Control Devices and published by FHWA in 1975. The purpose of this project is to update the 1975 handbook so that it represents best current practices for the application of traffic control devices. The revised version of the Traffic Control Devices handbook is intended to serve as an operating guide that can be used in conjunction with the Uniform Manual. The updated book is intended to provide a "how-to-do-it" guide for implementing the standards contained in the National Manual.

A draft handbook was completed during 1980 and the final version is scheduled to be submitted in June 1981.

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Freeway Management Handbook

The objective of this contract is to determine the best current practices in freeway management. The handbook will include surveillance, contract strategies, simulation, incident management, and communications. A literature search has been completed. A handbook outline has been developed and preparation of handbook chapters is underway. A draft of the handbook is scheduled to be completed during the fall of 1981. On completion of the handbook, a 3-day training course and a brief overview presentation will be prepared.

Freeway Management Handbook

New Directions in Roadway Lighting

Roadway lighting design specifications are currently presented in units of levels of horizontal illumination and uniformity ratios. Recent Federal Highway Administration research, along with the work of others, has demonstrated that an improved design method is possible.

The Illumination Engineering Society (IES) has made plans to adopt a new design procedure based on luminance in future editions of "American Standard Practice for Roadway Lighting." There is a need to explain the change in standards to State, county, and city engineers responsible for public roadway lighting. The goal of this project is to provide an easy-to-understand explanation of the new IES luminance criteria, its potantial impacts, advantages, and necessary design changes.

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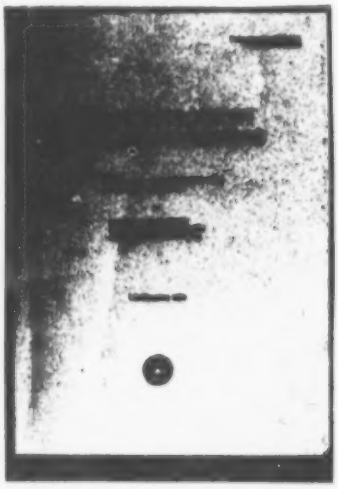
A Technology Sharing Report TS-80-233 titled "New Directions in Roadway Lighting" has been published along with a 15 minute slide-tape presentation.



Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials

The guidelines explain techniques that may be used for evaluating alternative highway routes for hazardous materials movements. The routing methods are described in readily understandable terms and are intended for use by State officials, planners and engineers. The guide may be used to evaluate interstate highways, urban arterials, and rural highways according to the risks that hazardous materials movements on these roadways pass to nearby populations and property. The guide has been published as Implementation Package IP-80-15.

User Guide for Removal of Not Needed Traffic Signals

This "USERS GUIDE" is provided to help city, county, and State officials determine if an existing traffic signal should be removed. The guide contains suggested removal criteria along with guidelines for carrying out the actual removal. To aid in the analysis process, easy to use "Signal Removal-Worksheets" are included in the guide.

The User Guide has been published as Implementation Package 80-12.

BEST DOCUMENT AVAILABLE

Traffic Systems Development Program -- Charles Stockfisch
Robert E. Ellington
David R. Gibson

The objective of the Traffic Systems Development program area is to identify, develop, evaluate, and facilitate the application of useable research and development results relating to traffic signal systems and transportation simulation on networks, arterials and freeways.

This program covers the broad area of traffic engineering discipline as related to safe and efficient operation of the Nation's urban roadway network. Due to increased awareness and emphasis by States and municipalities on advanced computerized control systems, the program is extensively involved in systems development, which includes the latest in systems engineering, computer software development, and traffic modeling and simulation.

The broad range of FCP research outputs emanating from this program area requires the application of a great variety of implementation approaches. Interested audiences may include city and State engineers and managers. User packages will vary from documentation in the form of a simple checklist for signal specifications to comprehensive handbooks, user manuals, and programs which assist the traffic engineer in the full-scale installation and operation of a computerized traffic surveillance and control system.

Extended UTCS Support and Maintenance

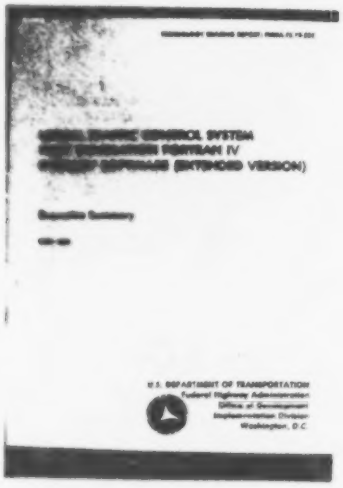
A contract with Kessmannn and Associates will be negotiated to provide support to those jurisdictions planning to implement the Extended Version of the UTCS software. The support function will include onsite and offsite consultation and advice on any aspect of the software.

The contractor will also maintain the software and related documentation if any errors that are uncovered during the support function.

UTCS First Generation FORTRAN Installation and Test-City of Charlotte, NC

We were notified in July 1980 that DeLeuw, Cather and Co. is no longer active in the computerized traffic control field. Because of their decision, the support phase of the contract was not extended and the contract was closed out.

It was under this contract that the current FHWA supported software, Extended Version - UTCS, was developed. Because this software will need continued support, a new effort, "Extended UTCS Support and Maintenance", will be initiated with Kessmann and Associates.



Installation and Demonstration of UTCS First Generation FORTRAN IV in Clearwater, FL

In order for the traffic engineering community to gain further acceptance of the UTCS software, a project to install the Extended Version in Clearwater, Florida's control system was initiated. The installation was completed in February 1980 and has been operational ever sinc.e The city traffic engineer and chief of police are very pleased with the system. The system is operating so efficiently that the number of police officers required for traffic control during the Easter holiday was drastically reduced. This contract, which was started in October 1978, has been closed out.

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Self Powered Vehicle Detector

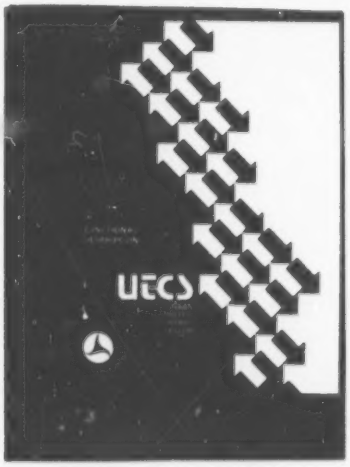
Self powered vehicle detector (SPVD) testing is continuing in four different locations. The most recent data received was a draft final report from Kettering, Ohio. An SPVD has been monitored for approximately one year by the city's computer traffic control system. The unit operated flawlessly, and no maintenance calls were necessary. Correlation between the SPVD and a standard 6 foot by 6 foot loop detector was extremely close. This data, combined with earlier data from the Dade County, Florida test, shows that the SPVD may be ready for an extensive implementation effort and the development of a production model by several manufacturers. The data that was expected from Charlotte, North Carolina has not been submitted These units have been removed and will be relocated to another city for testing.

UTCS Functional Specification Handbook

This handbook is intended to provide functional hardware specifications and functional acceptance test procedures which can be used as a model by users in the preparation of procurement and testing specifications for computerized traffic signal control systems. The handbook will address each hardware element, subsystem, and the total system; and the specifications will allow for the operation of each element in the UTCS Enhanced Software, as described in Functional Description publication FHWA-TS-79-228. Preparation of the procurement package was completed in FY 1980, and a contract award is expected in FY 1981.

UTCS Software Implementation Support (Enhancement)

There has been a number of developments which indicate that enhancements to the current FHWA software packages are needed before wider acceptance by the States and municipalities can be expected. The development work on this software, which is based on the new structured programing technique, is essentially complete. The software package was conditionally accepted after the testing in July. Even though the software has not been given a final acceptance, it has been controlling the Broward County, Florida system in a time-of-day mode since August 1979. In order to gain further confidence and public acceptance, a pilot cities program will be undertaken. Birmingham, Alabama has tentatively been selected as the first pilot city because it will provide a test for the complete software package. Additional pilot cities may be selected next year under a new project. The software will not be made available until it is fully operational in the first pilot city.



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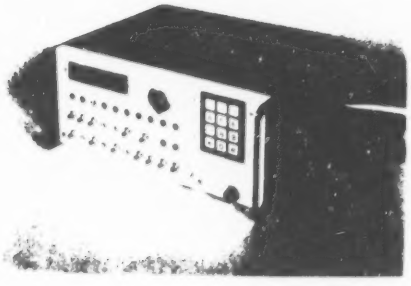
SIGOP II Development

This program is the successor to the original SIGOP (Signal Optimization) program developed in 1966 and designed to calculate traffic signal timing patterns for a network of intersections. SIGOP II utilizes a new optimization algorithm and revised input formulation. This program can be used for timing signals on any signalized network or arterial regardless of the type of hardware used. The program development has been completed, and tests and evaluations were started in Charlotte, North Carolina; Inglewood, California; and Broward County, Florida. A comparison of SIGOP-II and TRANSYT-7 will be made during the first half of 1981 in the cities of Birmingham, Alabama and Lexington, Kentucky. Such a comparison will show which program provides the best timing plans, and which is easier for the traffic engineer to use.

Traffic Controller Synchronizer

This is an in-house project to develop a method of "wireless interconnection" for traffic signal controllers. The objective is to provide a low-cost, versatile, accurate, alternative method of coordination using state-of-the-art technology. The synchronizer provides the same basic functions as present-day interconnect systems; however, timing accuracy will be maintained during power failures. The development work on the synchronizer has been completed and a contract is underway for the installation, testing, and evaluation of the device. At the test site, Virginia State Route 236 (Little River Turnpike), installation and preliminary evaluations have been completed. Preliminary results indicate that fuel consumption can be reduced by 50,000 gallons of gasoline per year for the 7 intersection system. The total cost to build and install the 7 units was $15,000 which is approximately 10 percent of the cost to install an equivalent hard wire interconnect system. Total installation time was one day with no disruption to traffic. The results of this study will be available in the summer of 1981.



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Diamond Interchange Traffic Signal Controller

The State of California has produced, under contract to the FHWA, purchase order specifications for an economical microprocessor diamond interchange traffic signal controller (Type 170). This flexible controller can function as a two- through eight-phase intersection controller, a ramp meter controller, a diamond interchange controller or an arterial master controller depending on the software used. Because of economical cost, interchangeability, and flexibility, California, New York, Oregon, and Ontario have adopted the Type 170 as their joint standard traffic signal controller. The controller is now being manufactured by at least six signal equipment suppliers. A followup project to improve user documentation on the various control strategies which are being used by the States of New York and California is currently underway.

Local Intersection Control Program

A Local Intersection Control Program has been developed for the Federal Highway Administration by the State of California Department of Transportation. This program implements the control logic described in the NEMA Traffic Signal Standard. This program is designed to operate with Type 170 Traffic Signal Controller Equipment. The program has been utilized both as a stand alone progam and in UTCS computer control systems. It can be used for a semi-actuated, fully actuated or volume density control depending on user inputs. It can implement two through eight phases using either single or dual ring logic depending on the phasing. Over eight hundred intersections are operating with this control program in the State of California. A report FHWA-IP-79-10 Local Intersection Control Program," was distributed by the Implementation Division. Copies are available for $5.00 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock #050-001-00168.

NETSIM Traffic Simulation

This simulation model, which was developed by the Office of Research, enables the user to evaluate the effects on traffic flow, of geometric and signal timing changes in urban networks, and of changes in bus stop locations and frequency of service. NETSIM--A User Guide, FHWA-IP-80-3 has been developed to facilitate the use of this model by others. A movie documenting the model's capabilities has been distributed to the FHWA regional offices. The course materials are currently being updated and pilot courses will be offered. New coding forms have been prepared to ease input preparation. The State of Michigan now performs over 1,000 NETSIM runs per year in their evaluation of new projects. A coding handbook will be distributed during calender year 1981. A pilot training course was presented in Idaho in November 1980.

NETSIM Conference

A contract has been awarded to the Transportation Research Board to hold a users conference on the NETSIM Model in from 6 to 12 months. The conference will include presentations by users on their experiences with the model and with both advantages and disadvantages of the model. The conference is aimed at practicing traffic engineers and not at the research community.

MAXBAND

Copies of MAXBAND have been sent to the Virginia and Michigan Highway Department for evaluation purposes. A copy has been sent to the University of Florida at Gainesville for evaluation as to the level of effort to incorporate MAXBAND into the AAP. MAXBAND is a miminal bandwidth program for optimizing signal progression along arterials. The program is still under evaluation and will not be available for use for approximately twelve months. Persons desiring a current maximal bandwidth program should contact the Texas Department of Highways and Transportation to borrow the PASSER II program.

TRAF

The TRAF program is an operating system allowing the use of a family of traffic simulation models in an integrated system to simulate all traffic features of a transportation corridor, including arterials, freeways, central business districts, and two lane feeder roads. Of these only NETSIM is fully operational. Field trials of several of the other models are planned for FY 1982. A summary report describing TRAFLO (NETFLO plus FREEFLO) will be distributed during FY1981.

Traffic Simulation Handbook

In the first stage of this project, the state-of-the-practice in the use of traffic simulation and optimization models as traffic operational analysis tools was reviewed. In the second stage, a manual is being developed to describe the most promising models, their use, computer resource requirements and engineering staff time requirements. A computer tape will be prepared which has all the models which are described in the Traffic Operations Analysis Handbook in source code form. By using the Handbook, the traffic engineer will be able to select the Traffic Operations Analysis program most appropriate to the problem to be solved. Many of the simulation programs in the Handbook are products of the FCP Research Program.

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SOAP - Signal Operations Analysis Package: Arterial Analysis Package

This ANSI FORTRAN Computer Program analyzes signal operations at individual intersections. SOAP has successfully undergone a year of field testing by the Florida State DOT prior to release of the documentation. In addition to the computer program and its related user documentation, a simplified version which can be used in desk top calculators has been developed and documented. The reports have been distributed. A loan copy of the FORTRAN Computer Program in source form is available from the Office of Development. A slide tape describing the program and its uses has been distributed to each Division Office. The SOAP program is being consolidated with the two Texas PASSER programs and the British TRANSYT program in an Arterial Analysis Package (AAP). A training course is being prepared on the AAP by the University of Florida which should be available in approximately 12 months. The AAP allows all four signal timing programs to be used with a single format for input data.

TRANSYT

A total of 23 copies of the TRANSYT Signal Timing Program were distributed in 1979. This program can optimize fixed time signals for buses and cars. It does not produce gasoline and emissions data but does estimate stops and delay. It is supported by the British Road Research Laboratory, which issues a new version approximately every 2 years. TRANSYT has been a very successful technology transfer project. It has been declared fully operational. Responsibility for the TRANSYT program has been transferred to the Office of Traffic Operations. Based on estimates by the Office of Traffic Operations over $4 million per year in fuel costs have been saved by this technology transfer effort.

Traffic Detector Handbook

A handbook on the selection use and maintenance of vehicle detectors for traffic control is being written. The handbook will also serve as the major instructional aid for a training course. Both inductive loops and magnetometers will be covered in detail. The report will be ready in approximately 1 year.

Energy Management - A Method for Estimating Fuel Consumption and Vehicle Emissions on Urban Networks and Arterials

The Emergency Energy Conservation Act of 1979 requires States to formulate energy conservation plans including a transportation element.

The Executive Order 12185 (December 17, 1979) requires FHWA to review Federal Aid programs with respect to supporting projects offering substantive energy conservation potential. As one such program, FHWA has identified traffic signal improvements for inclusion in the overall plan.

The Federal Clean Air Act (as revised Aug. 7, 1977) requires States to develop a State Implementation Plan including a transportation control element to enforce the National Ambient Air Quality standards and provides for sanctions including witholding of Federal-aid for highways if the targets are not met by 1982 or 1987 for certain cases. As part of the Implementation Plan, the States are also required to analyze CO emissions at "hotspots" such as signalized intersections.

The search for, and analysis of information from many sources revealed that the average speed in urban driving cycle i.e. stop and go traffic is a good composite parameter for determining fuel consumption and vehicle emissions. Data was obtained for passenger cars, trucks and busses speed-fuel profiles and a guideline has been prepared which allows local traffic engineers to compute fuel consumption and emissions based only on volumes, vehicle classifications and average flow speeds on an arterial or network.

This guideline should greatly facilitate the determination of these required measures either for defining the existing operating conditions or proposed or actual improvements without extensive field data collection effort required by computer programs or other techniques.

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